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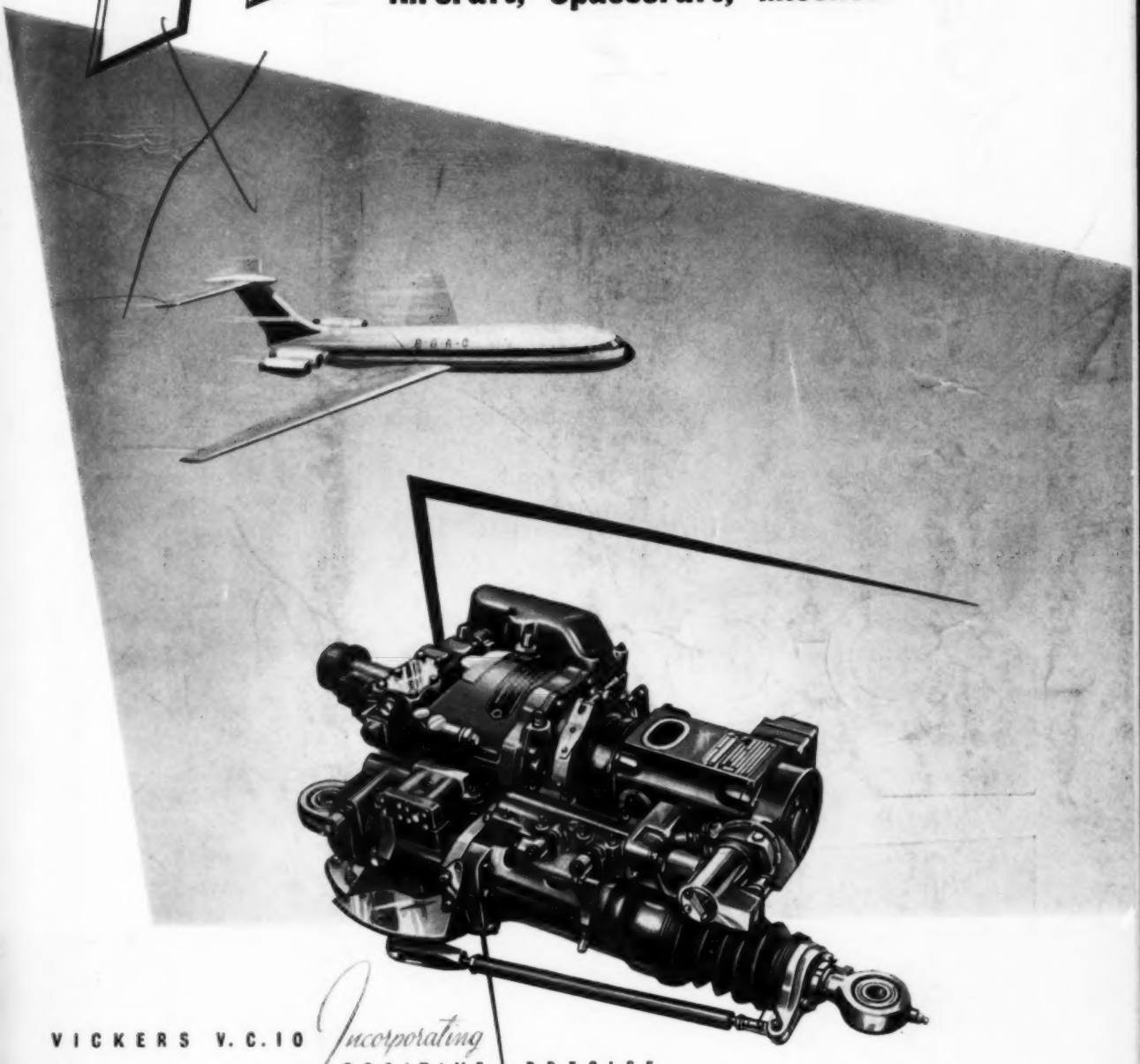

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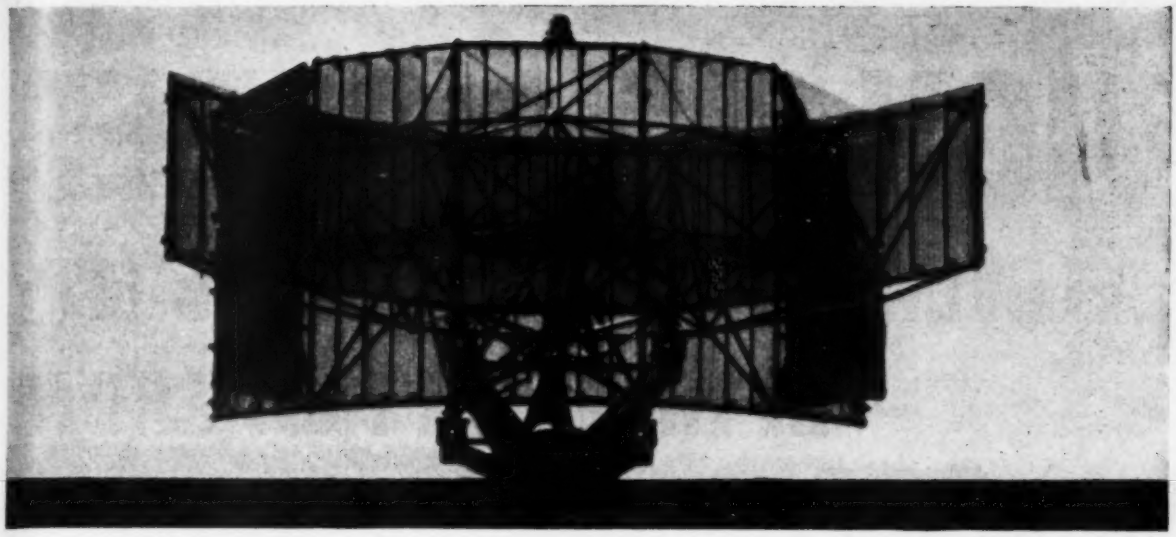

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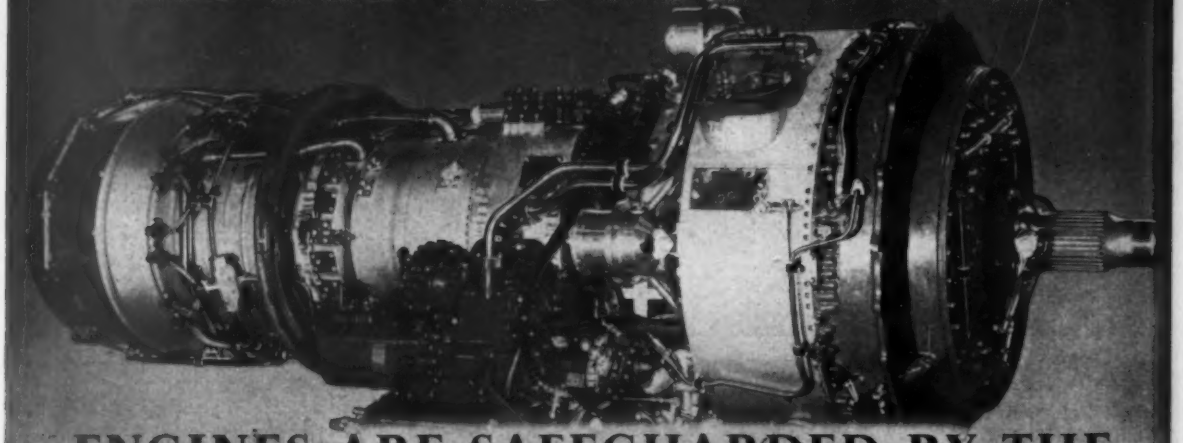

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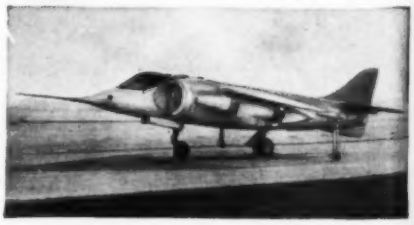

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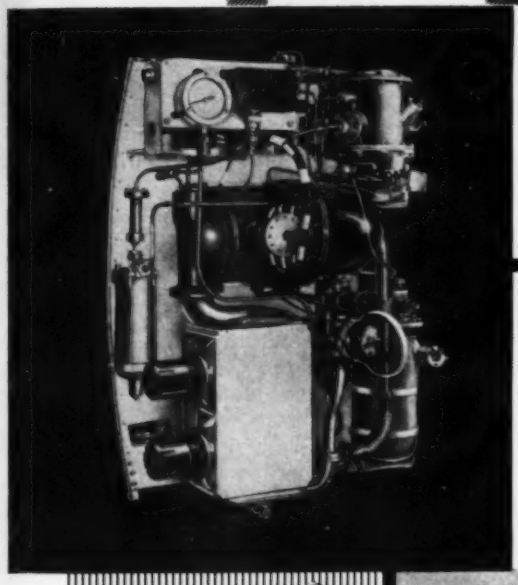

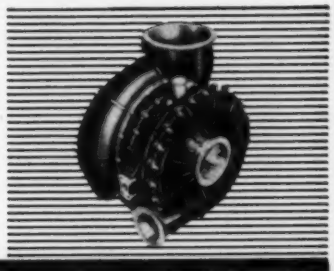

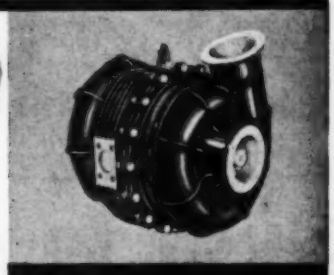

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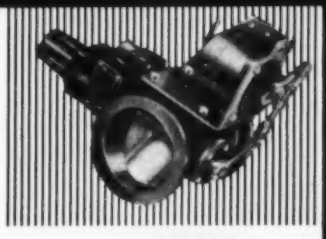

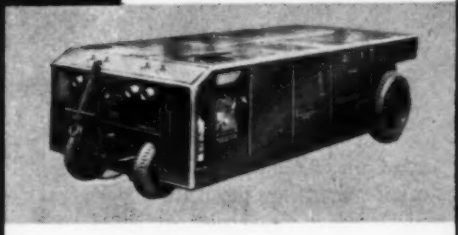

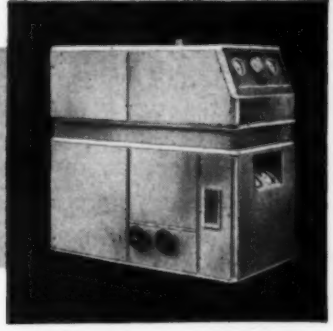

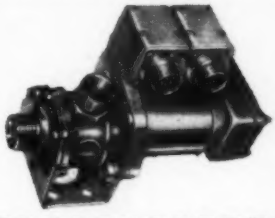

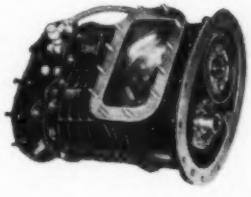

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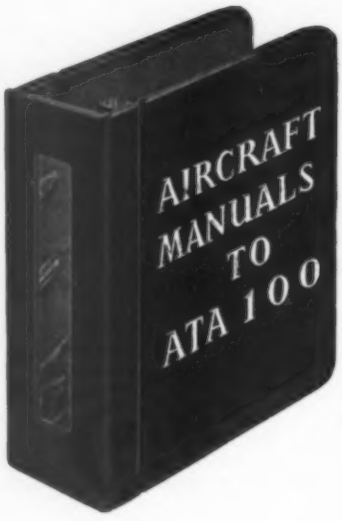

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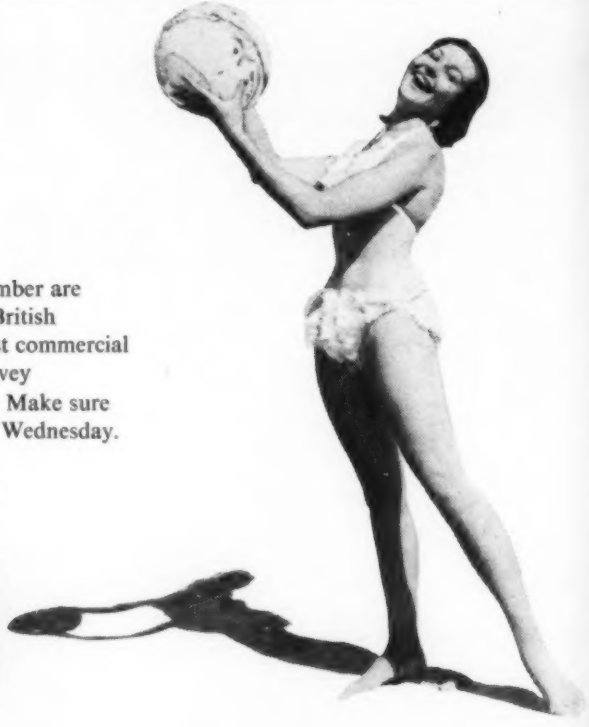

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These figures are based on the system used by Air Ministry for determining costs and include fuel, oil, spare parts, replacement of wastage and 3rd and 4th line maintenance at contractors.

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IN THIS ISSUE

From All Quarters 2
Missiles and Spaceflight 4
Grumman AO-1AF Mohawk in the Air 10
Flight System Survey 13
Makran Survey 14
ATLB's 21st Hearing 16
Sport and Business 18
Specialist-alloy Facility 19
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Europe and Space

IDEAS were in the air on the final day of the European Symposium on Space Technology in London last week. Ideas as to why, how, when and where Europe should get into space exploration. An MP reviewed the case for space; industry showed itself impatiently restless on the starting-line; and a senior National Aeronautics and Space Administration official talked good sense in presenting the United States view on international co-operation.

But much of all this had been heard before. What was new this time was the presence of two visitors from the field of nuclear energy—and with them a breath of fresh air blowing over some stale misconceptions. Delegates welcomed the enthusiasm, sincerity and confidence of the scientist from CERN (European Organization for Nuclear Research) and the lawyer from the ENEA (European Nuclear Energy Agency).

Many of those present realized for the first time that, where space research stands today in Europe, high-energy nuclear physics stood a decade ago. Today, the CERN laboratories at Meyrin are unsurpassed. Under the auspices of ENEA, thirteen European countries are working together in the Eurochemic irradiated-fuels project in Belgium; twelve are working on the Halden reactor project in Norway; and twelve with the Dragon reactor programme at Winfrith in Dorset.

In the foregoing examples is a precedent of success—not merely to be copied, for this would simply not work; but to be studied, noted and used for informed planning and action. In this way Europe can demonstrate that eleven-country co-operation need not result—as an American delegate to the symposium tongue-in-cheekily suggested it might—in an eleven-stage booster.

At the Threshold

On the matter of basic principles for Europe, there is no more apt quotation than the words with which an American, Dr Arnold Frutkin of NASA, opened his paper at the London meeting:—

"When viewed against the long time-scale of the future, it becomes apparent that all of us, from whatever nation, stand only at the threshold of space research and exploration. Some of us have taken a step or two; others have yet to do so. But there is not so much distance between us that those in front cannot pull, or those behind push. With some judicious pulling and pushing, the forward progress of all may be facilitated.

"At least two considerations dominate in dictating such co-operation among the nations. One is the desire of men of goodwill to see that a pattern of peaceful purposes and methods characterizes our response to the infinite challenge of space. Second, those nations which recognize the costs of space activity to be beyond their individual scope nevertheless desire to pool their resources in order to share in the activity and keep abreast of the new technology. The realization of both considerations is in the general interest."

While the European Space Research Organization is wasting no time in getting itself organized, realization of a European space-launcher programme is dependent on approval from European countries other than France and Britain—in particular, from West Germany. Although, as Mr David Price, MP, has pointed out, Britain and France would have the resources to accomplish the programme alone if necessary, this is not the answer. At this critical time we need enthusiasm from Europe just as much as we need enthusiasm for space.

FROM ALL QUARTERS

January-May Exports

EXPORTS by the British aircraft industry during the first five months of this year amounted to more than £67m—£2m more than for the same period last year. The total was made up as follows: aircraft and parts, £27m; engines and parts, £37.1m; electrical equipment, £1.5m; instruments, £1m; tyres, £428,421. Leading aircraft buyers during the five months were Canada (£10m) and the Lebanon (£3.8m). Canada was also the leading engine customer (£8.7m), followed by the US (£7.8m).

Carrier to Kuwait

A FIRST operational landing by the Royal Navy's first Commando Carrier, HMS *Bulwark*, was made when she put ashore men of 42 (RM) Commando at Kuwait last Saturday. The carrier was at Karachi, a thousand miles away, when she received orders to proceed on the previous Wednesday evening.

The landings have been a combined operation: troops were flown in from Aden and Nairobi by aircraft of NEAF and of Transport Command; and the RAF has also put in a Hunter wing and a squadron of Canberras from RAF Germany, the latter being sent to Sharjah.

SBAC Officers

THE Council of the Society of British Aircraft Constructors has elected the Hon H. G. Nelson as President of the Society for 1961-62, with Sir Roy Dobson, CBE, JP, as Vice-President. Sir George Dowty, who was President in 1960-61, becomes Deputy President. Sir Frederick Handley Page, CBE, has been re-elected Treasurer.

The Hon H. G. Nelson

Mr Nelson is managing director of the English Electric Co Ltd, chairman of English Electric Aviation, deputy chairman of British Aircraft Corporation Ltd, and of many of the English Electric Co subsidiary companies. Sir Roy Dobson is vice-chairman and managing director of Hawker Siddeley Group, chairman of Hawker Siddeley Aviation and of Hawker Siddeley Industries. He is either chairman or a member of the boards of all the group's operating companies and of many other subsidiary and associated companies. Sir George Dowty is founder, chairman and managing director of the Dowty Group. The original company, Aircraft Components, was founded by him in 1931.

Membership of the Council for 1961-62 is as follows:—

Ordinary Members: B. Boxall, Scottish Aviation Ltd; Air Chief Marshal Sir Harry Broadhurst, GCB, KBE, DSO, DFC, AFC, A. V. Roe & Co Ltd (Weapons Research Division); H. Buckingham, de Havilland Engine Co Ltd; Sir Aubrey Burke, OBE, de Havilland Aircraft Co Ltd; H. Burroughes, Gloster Aircraft Co Ltd; The Viscount Caldecote, DSC, English Electric Aviation Ltd (Aircraft Division); H. E. C. de Chassiron, D. Napier & Son Ltd; A. G. Clark, The Plessey Co Ltd; D. C. Collins, Westland Aircraft Ltd (Fairey Aviation Division); Sir Roy Dobson, CBE, JP, A. V. Roe & Co Ltd; Sir George Dowty, Dowty Group Ltd; S. Z. de Ferranti, Ferranti Ltd; T. Gammon, OBE, Vickers-Armstrongs (Aircraft) Ltd; W. T. Gill, Rolls-Royce Ltd; Sir Arnold Hall, FRS, Bristol Siddeley Engines Ltd; Sir Frederick Handley Page, CBE, Handley Page Ltd; J. F. Harper, Bristol Aircraft (Guided Weapons Division); D. L. Hollis Williams, Westland Aircraft Ltd; A. F. Jopling, Blackburn Aircraft Ltd and Blackburn Engines Ltd; J. T. Lidbury, JP, Folland Aircraft Ltd and Hawker Aircraft Ltd; W. S. D. Lockwood, Sir W. G. Armstrong Whitworth Aircraft Ltd; P. G. Masefield, Beagle-Auster Aircraft Ltd; F. G. Miles, Beagle-Miles Aircraft Ltd; J. Morley, the Lucas Group; the Hon. H. G. Nelson, English Electric Aviation Ltd (Guided Weapons Division); J. D. North, Boulton Paul Aircraft Ltd; W. Oppenheimer, Westland Aircraft Ltd (Bristol Division); J. J. Parkes, Alvis Ltd; J. D. Pearson, JP, Rolls-Royce Ltd; Sir Reginald Verdon Smith, Bristol Siddeley Engines Ltd; C. H. Chichester Smith, DSC, Fairey Engineering Ltd; H. G. Sturgeon, de Havilland Aircraft Co Ltd; W. A. Summers, CBE, Hunting Aircraft Ltd; C. F. Uwins, OBE, AFC, Bristol Aircraft Ltd; E. Manley Walker, Handley Page (Reading) Ltd; E. C. Wheeldon, CBE, Westland Aircraft Ltd; C. E. Wrangham, CBE, Short Bros & Harland Ltd; J. Wright, CBE, Dunlop Rubber Co Ltd; R. P. H. Yapp, Vickers-Armstrongs (South Marston) Ltd.

Nominated Members of Council (Materials Group Committee) are Dr L. B. Pfeil, OBE, and W. Jackett Jr, and of the Equipment Group Committee, V. A. Higgs and T. Simpson.

Public Meeting 21 Goes On

ON pages 16, 17, 26 and 27 of this issue we continue our summary of the Air Transport Licensing Board's public meeting No 21, the main theme of which is the bid by British United Airways and Cunard Eagle, objected to by BEA, for new European routes. Proceedings at the adjourned hearing on June 29 and 30 will be reported next week; meanwhile a brief note on them is called for.

Mr Henry Marking of BEA continued his cross-examination of Mr D. A. Whybrow on BUA's traffic statistics. There were some questions from the Board and a brief re-examination of Mr Whybrow by BUA's counsel, Mr Gerald Gardiner, QC. Mr F. A. Laker, executive director of BUA, was examined by Mr Gardiner and subsequently cross-examined by Mr Marking. Mr Norman Ashton Hill, advocate for Cunard Eagle, was cross-examined by Mr Marking on the Cunard Eagle case. Mr Oswald of British Railways also cross-examined Mr Ashton Hill, who raised the valid point that the Board's duty is to further the development of British civil aviation. Mr Marking outlined BEA's general objections, and this completed Thursday's hearing.

On Friday Mr Anthony Milward, chief executive of BEA, gave evidence for BEA's general objections, and was cross-examined by Mr Gardiner for BUA, by Mr Ashton Hill for Cunard Eagle and by Mr Porter for Tradair. Mr Milward also answered some questions from the Board and was briefly re-examined by BEA's own advocate, Mr Marking.

The next witness for BEA was Sir George Cribbett, formerly in charge of traffic rights at the Ministry (and, until his retirement last year, deputy chairman of BOAC). Sir George warned of the likely serious effect of the independents' applications on Britain's bilateral agreements. Evidence and brief cross-examination by Mr Gardiner occupied the rest of Friday.

India's Jet Fighter Flies

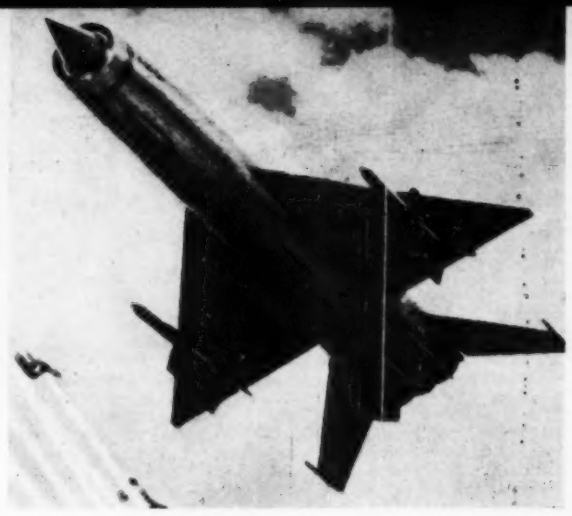
ON Saturday, June 24, India became the sixth nation to have a supersonic aeroplane. On that day Wg Cdr Suranjan Das, famous for his evaluations of many British and other jet fighters, took the Hindustan HF-24 into the air from the airfield adjoining the main plant of the Hindustan Aircraft Factory. This culminated five years of design and development, under the leadership of the company's director of engineering Prof Dr Kurt Tank, renowned chief designer of Focke-Wulf during World War II.

It was in 1955 that the Indian Air Force decided to finance an indigenous jet fighter specially tailored to their own requirements, while Folland Gnat Mk 1s were purchased and put into production by Hindustan as an interim machine. The Gnat's Bristol Siddeley Orpheus 701 engine was also put into production at Hindustan's specially built jet-engine factory. Even with help from Folland and Bristol Siddeley, in the form of drawings and parts, and by purchasing a wide range of British proprietary equipment, the Gnat programme was a difficult task for a nation previously completely unskilled in the manufacture of high-speed aircraft.

While the Gnat programme took shape so did the HF-24. It was from the outset a single-seat, twin-Orpheus 701 machine, with a swept, dog-tooth wing of some 5 per cent t/c ratio, high-lift flaps, an area-ruled fuselage and a low-mounted slab tail. Four guns (30mm Adens?) form internal armament, and it is likely that a radar fire-control such as Ferranti Airpass 2 will eventually be integrated. The HF-24 has always been intended to serve strike and reconnaissance roles, in addition to its prime fighter function.

Slow-speed features were explored at the Indian Institute of Science at Bangalore; and it may well be that time has been rented in at least one high-speed tunnel outside India. The first prototype, about half of which is entirely Indian in origin, was rolled out earlier this year, but suffered damage during taxying trials. Finally Wg Cdr Das was given a fully serviceable aircraft, and on June 24 he disported over Bangalore for 20min, watched by Defence

FIRST INDIAN JET FIGHTER, the Hindustan HF-24, at Bangalore after its maiden flight on June 24 (see news-item above)



FIRST PICTURE of a Soviet fighter carrying air-to-air guided weapons. Apparently derived from the Sukhoi prototype illustrated in our issue of June 29, 1956, the aircraft appears to be twin-engined, like the familiar Mig-19. When the FAI claim of 1,484 m.p.h. was filed for the "E-66," the engine type was given as "RS-7F, 13,117lb thrust," and it may be that this is the aircraft depicted, and that it has two of these engines. The circular, double-shock intake and moving-wing Sparrow-shaped guided weapons are noteworthy

Minister Mr V. K. Krishna Menon, who had journeyed there to witness the flight. Mr Menon saw the HF-24 rolled twice, and one report claims that M1 was exceeded. In the factory an embryonic production line is already taking shape, and later versions of the aircraft will have increased power—possibly Orpheus 801s or even BOr.12SRs. All details of the aircraft are restricted, beyond the fact that its length is about 50ft and that the seat is an automatic Martin-Baker design.

US Military Aircraft

THE following notes embrace some of the recent major decisions and discussions on military aircraft emanating from the Pentagon:—

US Air Force By far the largest single vote in the Fiscal Year 1962 (beginning last Saturday) budget for military aircraft is $525m for strategic bombers. This sum would purchase and operate for five years approximately 23 B-52Hs, 20 B-58s or 80 silo-based Minuteman missiles. Defense Secretary McNamara has publicly expressed his opposition to substantial procurement of more manned bombers, and the money may, in fact, further accelerate the deployment of the fixed-base Minuteman. The train-borne Minuteman suddenly appears less attractive, and, as already reported, there is no money for it in FY62. Largest single vote for a named type of aircraft is $397.4m for the Republic RF/F-105D ($27.5m of this being for the RF), the unit price being $1,263,000. Next largest sums are $236.7m for 83 Lockheed C-130Es, $230m for an undisclosed number (about 65) of Boeing KC-135As, and $218m for four additional B-70 test aircraft. The last-named figure shows that the massive lobby urging acceleration of the 2,000 m.p.h. bomber has been defeated. Total USAF procurement amounts to 573 new aircraft, which will cost $3,547m including direct support facilities.

US Navy After lengthy negotiations, it appears that the Navy is likely to ask for the Grumman Gulfstream, probably designated RF-1, as a replacement for approximately 200 Douglas R4D (DC-3) transports. Not only is Grumman a Navy plant but the Gulfstream flies San Francisco to Hawaii non-stop (a requirement) and its capacity is more in line with that of the R4D. The competing Fairchild F-27 is more costly to operate over longer stages, and its choice would mean re-opening a production line at a low rate of output; moreover, 40-seat requirements are already "adequately met" by the R4Y (Convair 340). Whichever aircraft is adopted, the Rolls-Royce Dart may be replaced by the General Electric T64 (*Flight*, January 13), for the obvious political reasons of having a US source and helping to justify the heavy Navy investment in this engine. There is no FY62 money for the A3J Vigilante, although North American's backlog of $296m for the 52 aircraft outstanding is exceeded only by McDonnell ($361.6m for 144 Phantom 2s) and Grumman ($391.2m for 113 aircraft, principally A2F Intruders and W2F Hawkeyes).

US Army Way out in front is Bell Helicopter, with $67.6m for no fewer than 242 of the improved HU-1B Iroquois. The Grumman Mohawk (see pages 10-12 of this issue) accounts for $42.8m for 48 aircraft, $12.6m more than do the same number of de Havilland AC-1 Caribous. Last month it was stated at Ft Eustis that 61 Caribous have so far been ordered from Downsview, and that "the Army would like to procure about 300."

Joint Service The long-drawn-out negotiations for a V/STOL fighter programme appear to have resulted in the USAF being cleared to award a major study contract for an air-superiority defensive machine (probably M2.5, and 2,500 n.m. ferry range) while the Navy go ahead in conjunction with the Army and Marine Corps on a tactical strike aircraft (not more than M2).

Higher-powered Hovercraft

SO that experience can be gained in operating the Hovercraft "at speeds more representative of those at which commercial hovercraft will be used," the SR.N1 is to be fitted with a Bristol Siddeley Viper engine, loaned to Hovercraft Development Ltd by the Ministry of Aviation. Its 1,500lb thrust—an increase of 700lb over the Marboré with which the Hovercraft was fitted in April last year—will give SR.N1 a maximum speed of 65kt.

Originally it was propelled by air drawn from the central compressor and then expelled through propulsion ducts on each side of the craft. Total propulsive power then available was about 400lb, giving the craft a maximum still-air speed of 25kt and a hovering height of 13in. Replacement by the Marboré, with a thrust of 800lb, increased the maximum speed to 45kt. Much operating experience has been gained at this higher speed.

Beagle Finance Facilities

DEMONSTRATING that in its commercial policy it is as vigorous and forward-looking as it is in the matters of aircraft design and manufacture, Beagle has jumped into the forefront of aviation commercial practice by creating a financial subsidiary within the group. The new company, Beagle Aviation Finance Ltd, offers facilities for leasing and hire-purchasing Beagle aircraft.

Two basic schemes are available. The aircraft can be leased over a five-year period at an annual rental of one-quarter of the cash price, after which the lease is renewable annually at a rental of one-sixteenth of the cash price. During the period of the lease, all the costs of the aircraft are chargeable to the lessor's revenue account.

Alternatively, those who wish to purchase the aircraft out of income can pay for it over a period of three years following an initial down-payment of not less than one-fifth of the cash price. As with the leasing arrangements, the finance charge and running costs are chargeable to the purchaser's revenue account, but the instalments are, of course, chargeable to capital account.

IN BRIEF

The Australian order for Westland Wessex helicopters (this page, last week) is for 27 Mk 31s.

Nine officers of the French Armée de L'Air and one officer of the Aeronavale recently visited Martin-Baker Aircraft at Denham to familiarize themselves with the latest Martin-Baker ejection seats, particularly the AM4 and N4 as installed in the Mirage and Etendard.

Flown by Walter Moody, a pilot in Max Conrad's aircraft-ferry organization, the first Mooney Mark 21 to arrive in this country landed at London Airport on Saturday last, July 1, after a 7,000-mile non-stop flight from Kerrsville, Texas.

Mr Roy E. LeLong, who as a fighter pilot shot down the first German aircraft on D-Day, is rejoining Armstrong Whitworth Aircraft at Coventry as general sales manager. He served with the RNZAF and the RAF in the Second World War and with the USAF in Korea, winning decorations with all three Forces. In 1953 he commanded No 43 Sqn and led the first RAF Hunter aerobatic team. He joined AWA in 1958.

TWENTY Marcel Dassault Mirage IIIcs for the French Air Force. These are now coming off the assembly line at Bordeaux-Merignac, and the first unit to receive them will be the Dijon Wing, the pilots of which are taking conversion courses at Mont-de-Marsan (Landes)

Missiles and Spaceflight

US NAVY TRIPLETS DOING FINE

"It looks like the most successful launch we have had," were the words used by Vice-Admiral J. T. Hayward, US Navy DC Ops Development, to describe the launch on June 29 of three satellites at once. The vehicle used was a Thor-AbleStar, and all three devices achieved "excellent orbits," with inclination of 67°, apogee and perigee of 629/550 miles and period of 104min. The trio should have a life of at least 50 years. Unfortunately the two smaller payloads failed to separate.

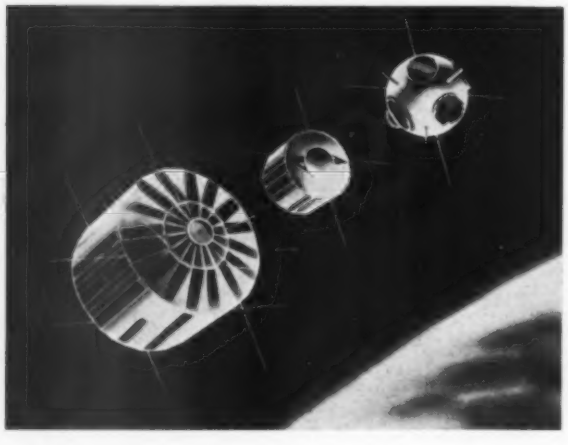
By far the largest payload is Transit 4A, weighing 175lb, and marking a distinct advance in containing a working nuclear power generator weighing 4.5lb. Source is a cylinder of Pu_{238} encased in a heavy shield, the thermal decay energy being converted into electric power by the Seebeck thermo-electric process. Barring malfunction, the generator should operate throughout the lifetime of the satellite, the half-life of this plutonium being 90 years. The two smaller partners are Injun and Greb 3, both of which are investigating radiation. The 40lb Injun is interested in the relationship between magnetic fields, radiation and the auroræ, while 55lb Greb 3 is studying solar radiation and its connection with ionospheric disturbances and radio interference on Earth.

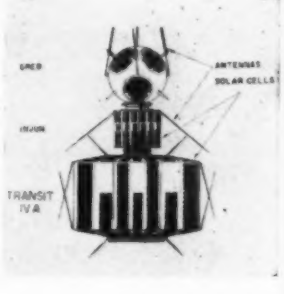
THE GIANT SOLID BOOSTER

Since it is now a *sine qua non* that the new solid propellants have led to drastic reductions in cost, complexity, development time and unreliability in military ballistic missiles, it is only a matter of time before liquid-propellant engines find the new solids serious rivals in the boost propulsion of spacecraft. Although enormous sums are being voted for the continued development of large liquid engines (in particular, the F-1, described in our June 15 issue), negotiations have for some time been taking place between the National Aeronautics and Space Administration and the Department of Defense with a view to the development of solid-propellant boost stages comparable in performance with those using multiple F-1 engines.

Although no project has yet reached the engineering stage, it is broadly envisaged that the USAF will develop a multi-engine first stage with a thrust of the order of 10,000,000lb, engineered to NASA requirements but in no way limited by the latter. In the present state of the art it appears obvious that, other things being equal, a solid booster will be cheaper than a liquid one in all respects; and whether the space payload is to be of a military, scientific or commercial nature, this fact will be of enormous importance in costings running into hundreds of millions.

Clearly, the new solid booster will act as a parallel back-up to the many schemes employing the liquid F-1, chief among which are the Saturn C-3—which NASA is to farm out to industry—and the many variations of the Nova concept. Funding of the giant solid is being initiated with the $62m requested by the President for this purpose in the Department of Defense budget for the forthcoming fiscal year, as related in our June 22 issue (wherein it was also noted that an eventual selection is to be made between liquids and solids for future manned space exploration).





These three satellites, launched together by Thor-AbleStar on June 29, are discussed in the first news-item above. They represent the fourth stage in the establishment of a radio-navigation system. At right is the original payload package before separation took place

BIGGEST SOLID FIRED

"The greatest power ever produced by a solid rocket motor was unleashed June 3 in a special test firing for the USA ir Force at Aerojet's solid rocket plant, Sacramento." So opens the June 1961 edition of *Booster*, one of the publications produced monthly by Aerojet-General Corporation. The company's president, Dan A. Kimball, writes: "The motor was made up of three segments joined together just before firing. By splitting the unit into three basic pieces—front, centre section, and tail—we have a product we can make easily, transport easily, and then assemble at a launch site into an instrument of great power. By adding or subtracting the number of segments used, we can tailor the power of the motor to meet the requirements of the payload." Thrust produced was 500,000lb. The motor weighed 110,000lb and measured 8ft 4in diameter by 30ft long. Duration of the test was not given. This firing was not directly connected with the much large engines discussed in the previous news-item, competitive bids for which are to be invited from four contractors (one of whom will obviously be Aerojet-General).

TITAN 2 SPECIFICATIONS

Quantitative details of the Martin SM-68B Titan 2 ICBM were cleared for publication by the USAF last month. The new missile, which uses storable propellants and is designed to be launched from the bottom of its silo, is 102ft high, 32ft being the second stage; both stages have a diameter of 10 ft. Weight at lift-off is 300,000lb, 30,000lb over the original estimate, and thrusts at sea level of the two Aerojet-General powerplants are: first stage, 430,000lb; second stage, "about 100,000lb." Extensive testing has now taken place on both engines, and on June 7 captive firing of the complete second stage began at Martin's Denver division.

On June 28 the US Senate approved President Kennedy's accelerated space programme (*Flight*, June 1 and 22) and passed a vote of $1,784,300,000 for NASA for the financial year just begun.

An Atlas E suffered an internal malfunction and explosion two minutes after launching from Cape Canaveral on June 23. The E model is not working well; the previous launch almost destroyed a semi-hard "coffin" launcher at Vandenberg on June 7.

Chance Vought were on June 23 awarded a 21-month contract worth some $660,000, for the manufacture of the six 105in-diameter liquid-oxygen tanks for six Saturn S-1 first stages. Delivery will run from next April until January 1963.

The Martin Co, one of the three firms awarded design-study contracts for Project Apollo, has announced that over 30 companies are assisting in Martin's Apollo design work. The organizations involved include specialists in propulsion, guidance, recovery, tracking and telemetry, and environmental control.

During the night of June 17-18 the Soviet Navy sent three destroyers from the Black Sea into the Mediterranean. According to the London *Sunday Telegraph*, "Athens reports showed that one of the vessels was a missile carrier." The logical deduction is that the missiles are for anti-aircraft use, although anti-submarine warfare may be implied. The destroyers later passed through the English Channel.

Maj Gen Bruce K. Holloway, director of operational requirements, USAF, is quoted by *Aviation Week* as saying of North American's GAM-77 Hound Dog: "The guidance system proved not to have the reliability we had hoped, it did not have the accuracy we had hoped, they both sort of go together to degrade the overall effectiveness." The USAF have made over 100 "not cataclysmic" changes in the weapon, which should by now be operational with B-52G squadrons.

The party of British journalists touring American early-warning and missile centres as guests of the Department of Defense were on June 24 given a briefing on GAM-87 Skybolt by engineers at the Culver City plant of Douglas Aircraft. One of the revelations was that the original design of ALBM could fairly easily "have been intercepted by an anti-missile missile, but Douglas now feel that not only does the existing design (*Flight*, June 15) have much greater penetrative ability, but that it can be further developed to carry more advanced countermeasures and perhaps follow a non-ballistic trajectory. Compatibility tests, chiefly concerned with the aircraft-mounted components of the system, are at present proceeding with a Vulcan B.2 at Edwards AFB.

"Flight" photograph

Speakers at one of the discussion sessions at the European Symposium on Space Technology: from the left, Dr L. R. Shepherd, Air Cdre F. R. Banks, M F. Vinsonneau, Mr M. N. Golovine (chairman), Mr David Price, MP, and Mr Jerry Weinstein

EUROPE'S FUTURE IN SPACE

by Kenneth Owen

"THE exploration of space represents a new epoch in the development of mankind, and nothing could be more important than that this new step in human history should take place on a fully international basis. At the present time the basis of astronautics is far from international; the situation is dominated completely by the two largest nations in the world and the avowed objective of both of these countries is to try to be the first *nation* in space. This is an unsatisfactory situation that can only be remedied by a special effort on the part of other States to enter space on a co-operative basis."

This statement by Dr L. R. Shepherd at the European Symposium on Space Technology in London last week represents one of the arguments for a full European space programme. Other arguments have reached the same objective from different viewpoints—on the basis of national rather than international thinking. The main value of the symposium, which was organized jointly by the British Interplanetary Society and the Société Française d'Astronautique, lay in the thorough discussion of these motives and principles rather than the specialized content of the technical papers.

As an overall reference-source on the subject, the paper *Political and Economic Background to Space Co-operation* by Mr David Price, MP, was comprehensive and lucid. Based on the report presented by Mr Price to the Consultative Assembly of the Council of Europe last September, it is probably the best single presentation yet of the case for a European space programme. A major part of this paper, containing the author's discussion of the importance of space research to European countries and review of existing proposals for space-research co-operation, is printed in slightly abridged form on pages 7-9 as the latter section of this article.

Elsewhere in his paper Mr Price submitted that space research would produce scientific, technical and economic benefits. The scientific benefits were largely unpredictable; the technical and economic benefits included engineering advances in control, communication, power and structures, and the prospect of a communication satellite system; and there would be significant by-products and side-effects in electronics, power generation, cryogenic engineering, high-duty mechanical devices, materials and structures, fabrication techniques, chemical technology, biology and biochemistry.

For the USA and Russia, Mr Price said, the space race was part of the cold war. From the history of the US space programme he extracted four points as being relevant to Europe at the present time. First, the speed with which Project Vanguard—a complete satellite system—was accomplished. Secondly, the rapid progress which had followed the setting-up of the National Aeronautics and Space Administration as the single responsible body. Thirdly, the previous dissipation of effort and rivalry between a number of bodies. Fourthly, the enormous effort made since Sputnik 1 and the resulting "very impressive" results.

On only a few points was Mr Price wide of the mark and perhaps misleading. He stated: "There is a European rocket already available to launch a European satellite—the British Blue Streak." In fact neither Blue Streak nor a satellite-launching vehicle based on it is "already available." The official Anglo-French proposals put forward at the Strasbourg conference of January 1961 outlined the five-year development programme envisaged. This involved a minimum of eight and a maximum of ten firings, of which only the last three, scheduled for 1965, would be of the complete three-stage vehicle capable of launching a payload into orbit.

Discussing the possible purchase of US liquid-fuelled rockets such as Atlas, Mr Price said: "There would be a substantial time-lag before such rockets might become available. In the meantime Russia and America would be increasing their lead in space technology." It would be foolhardy not to appreciate that this applies to the same extent, and possibly to a greater extent, in the case of a European launch vehicle based on Blue Streak. To point this out is not to detract from the concept of the European vehicle; it is simply to attempt to correct the widespread apparent assumption that Europe's rocket is just about on the pad and ready to go.

Further, Mr Price states: "There is little evidence that either of these countries [USA and USSR] would be willing to sell space rockets to European countries for our independent use." A fair comment would be that there is no evidence that the USA, at least, would *not* be willing to sell such rockets for this use.

Much of the general discussion at the symposium suffered because of a particular gap in the material presented. This was the absence of any detailed description of the official Strasbourg proposals. As the whole future of European space technology may well hinge on the programme put forward by Britain and France on that occasion, this was a basic omission—presumably not the fault of the organizers—which inevitably detracted from the deliberations. The only published description of the Anglo-French proposals remains the full report, with detailed development programme, given in *Flight* of February 17, 1961.

Possible Ten-year European Space Programme 1961-1971 (Shepherd)

A. Vehicle Projects

1. Phase I launching vehicle (presently proposed project based upon Blue Streak).
2. Phase Ia launching vehicle, utilizing higher-energy propellants (i.e. liquid hydrogen/lox) in upper stages to increase payload capacity, but with same first stage as Phase I vehicle.
3. Phase 2 launching vehicle, capable of placing 10,000kg in a close orbit, based entirely on high-energy propellant stages, possibly with 500,000kg total thrust cluster of liquid hydrogen/lox engines in first stage.

Associated with these three main projects there would be the development of a small number of appropriate upper stages, some of them interchangeable between the three vehicles listed.

B. Applications

1. Instrument-carrying satellites and space probes for space research, utilizing Phase I and, in later stages, Phase Ia vehicles.
2. Soft-landing instrumented lunar probe utilizing Phase Ia vehicle.
3. Close and synchronous-orbit communications satellites. Series of launchings and tests leading to commercial use by *circa* 1970, utilizing Phase I and Ia vehicles.
4. Development of manned capsule or re-entry vehicle and its use with the Phase I vehicle for sub-orbital flight.

C. Research and Development

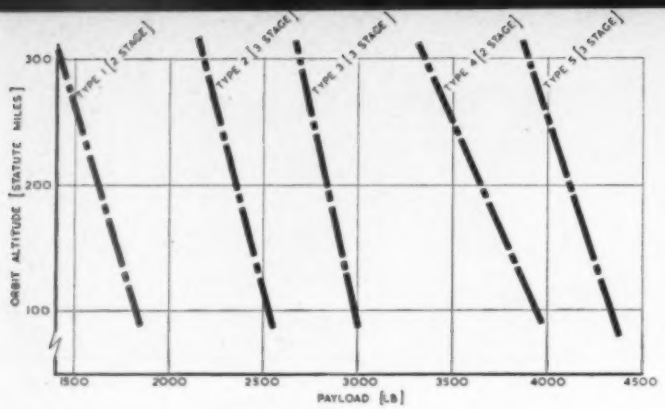
1. Full supporting research and development in all relevant areas connected with the projects and applications listed above.
2. Longer-term research and development, particularly on advanced propulsion systems that might be used in a second ten-year European programme, e.g. in nuclear propulsion.

The total cost of the above programme might amount to £500m, of which more than half would be associated with the vehicle development and its associated research and development.

In the absence of papers describing what Europe intended to do in space, the meeting did its best with what Europe might do in space, and what Europe was doing already in other fields. The parallel with nuclear energy was drawn, and found highly relevant.

In *Legal Problems arising from a Co-operative Space Programme* Mr Jerry L. Weinstein, counsellor to the European Nuclear Energy Agency of the Organization for European Economic Co-operation, emphasized that space problems were basically not very much different from the existing problems of international co-operation. The same approach as had been adopted for the European Organization for Nuclear Research (CERN) in Geneva might not be valid for the proposed European space launcher organization, but, once the objectives had been firmly defined, the legal problems could be identified and solved.

(Continued overleaf)



Taken from the paper "A Lightweight Solar Propulsion Unit for Transfer to a 24hr Orbit" by P. A. E. Stewart and J. F. Swale of the Advanced Projects Group, Hawker Siddeley Aviation, this diagram shows the performance of five launch vehicles based on Blue Streak. Type 1 comprises Blue Streak with Black Knight as second stage; type 2, the same vehicle with a third stage employing high-test peroxide and kerosine; type 3, the same vehicle with a liquid oxygen/liquid hydrogen third stage substituted; type 4 is a two-stage version using Blue Streak as first stage and a near-optimum liquid oxygen/liquid hydrogen second stage; type 5 shows a three-stage vehicle specially designed for the 300-mile circular orbit, i.e., with equal velocity increments (7,000ft/sec) for second and third stages

Missiles and Spaceflight . . .

Details of the CERN project were given by a scientist from the Geneva centre, Dr C. J. Zilverschoon, who said that, about a decade ago, high-energy physics in Europe faced exactly the same problems as were now facing space research. The two important factors in the success of the CERN experiment had been (*a*) the fact that it was a scientific organization, and (*b*) its ambitious programme. It had brought Europe to the forefront of high-energy nuclear research with the construction and operation of a 28GeV proton synchrotron (the largest accelerator in the world when planned) and a 600MeV synchro-cyclotron (similar to the largest in the world).

Mr G. K. C. Pardoe of de Havilland Aircraft suggested that the problem of international co-operation in space had been over-simplified, and that the conditions were different from those under which CERN had been established. The launch vehicle and the applications of its payload formed two main considerations, and the second of these involved pure research, civilian applications and military possibilities. This alleged difference was strongly denied by Mr Weinstein and by Dr L. R. Shepherd.

Dr Shepherd is in a unique position in any discussion of this particular relationship. For many years a protagonist of space exploration, and immediate past-president of the British Interplanetary Society, he is head of research and development on Project Dragon, the international programme for the construction and operation of a high-temperature gas-cooled reactor at the UK Atomic Energy Authority establishment at Winfrith. "We have *exactly* those problems," he commented. The whole basis of international co-operation, Dr Shepherd declared, was that one *must* oversimplify at the start, and deal later on with the complications. Otherwise one just did not start.

In Dr Shepherd's prepared paper, *A Ten-year Programme of Space Technology*, an extract from which introduced this article, the programme summarized on page 5 was proposed. Dr Shepherd went further than most speakers in the extent of co-operation envisaged:—

"While collaboration between the nations of Europe would be, in itself, a very important step forward, a still more significant end would be served if they took the opportunity of encouraging worldwide collaboration by making the membership of their enterprise open to any country in the world that might wish to join. An open policy of this kind could lay the foundation for a truly international advance into space, for not only would it open the door for the citizens of small countries anywhere in the world, but it could, by its eventual success, encourage the space-capable nations of America and Russia to throw their own vast resources into a common pool.

"Such a proposal, more ambitious in its philosophy than the mere establishment of a European third-space-power, should be no less ambitious in its scope. The joint undertaking should embrace the development of astronautical science and technology in the broadest possible manner, and make the fullest use of the combined economic resources of its members in order to achieve this objective."

Referring to the three-stage launch vehicle now proposed for Europe by Britain and France, Dr Shepherd said: "Such a vehicle is adequate for the purpose of carrying out many important exercises in space research and the initial steps in the development of communications satellites. It should be sufficient, furthermore, to launch manned vehicles into sub-orbits. However, it is important to appreciate at the outset the limitations of this vehicle and, as soon as possible, to take the steps leading to the development of larger and more powerful rockets."

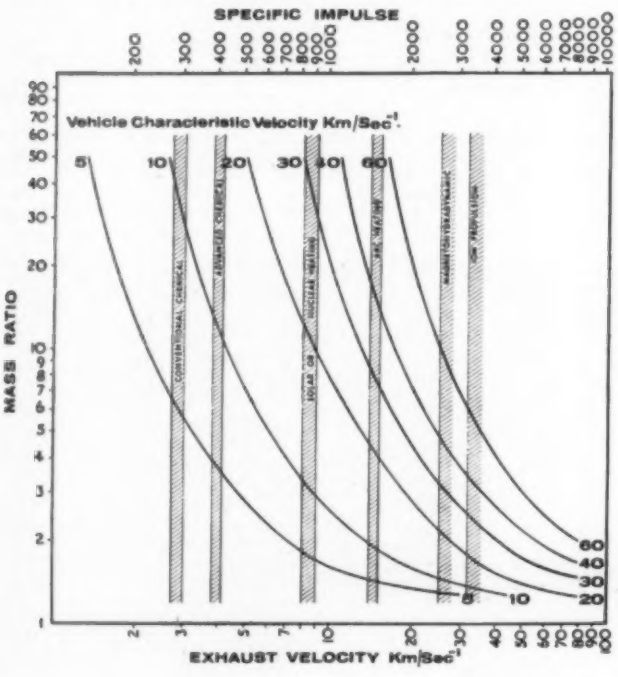
For the widely based programme which he proposed, Dr Shepherd submitted that the first step should be the setting-up, possibly under OEEC, of a European Space Development Agency. This agency would decide the scope and cost of the programme, divide the work into projects and areas, and allocate the work to centres in the participating countries.

Speaking on *New Aerospace Technologies*, M. F. Vinsonneau of SEREB (Société pour l'Etude et la Réalisation d'Engins Ballistiques) referred to the European industrial space study group known as Eurospace, whose formation in Paris on May 29 had followed the joint studies carried out by SEREB and Hawker Siddeley Aviation (*Flight*, March 3 and 10).

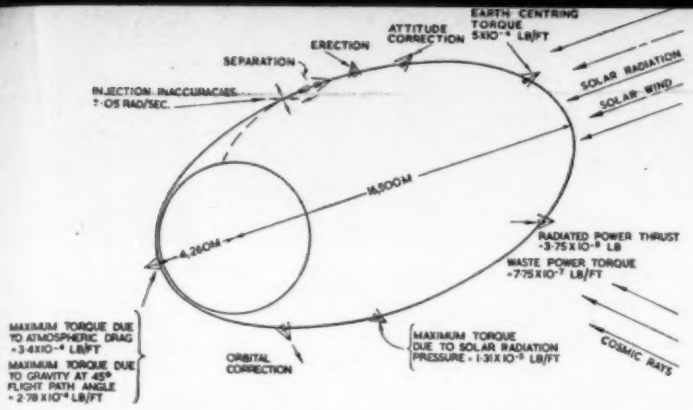
According to a Hawker Siddeley Aviation press release on the opening day of the symposium, working parties had now been established within Eurospace to examine and evaluate possible programmes, projects and budgets.

M. Vinsonneau, who is secretary-general of the new group, commented that Eurospace had made a good start and, if the large industries of Europe expressed a jointly held view, that view would be worth listening to.

"In another direction," he continued, "we have supported the plan for a heavy launcher based on Blue Streak. We have not pretended, either at home or to our friends abroad, that this is the only solution technically or economically pos-



This diagram, from "The Impact of Space Propulsion Technology on the Engineering Industry" by M. S. Hunt of Bristol Siddeley Engines, shows the performance of space propulsion systems. The nuclear rocket gives more than double the performance of the best chemical rocket and could form the basis of future first-stage boosters. Once in orbit, with high thrusts no longer needed, the electrical methods such as plasma and ion rockets offer enormous advantages


EARTH CENTRING TORQUE 5X10⁻⁴ LB/FT
ATTITUDE CORRECTION
ERECTION
SEPARATION
INJECTION INACCURACIES ·05 RAD/SEC.
SOLAR RADIATION
SOLAR WIND
11,500M
4,260M
RADIATED POWER THRUST ·3·75 X 10⁻⁹ LB
WASTE POWER TORQUE ·7·75X10⁻⁷ LB/FT
MAXIMUM TORQUE DUE TO ATMOSPHERIC DRAG ·34X10⁻⁴ LB/FT
MAXIMUM TORQUE DUE TO GRAVITY AT 45° FLIGHT PATH ANGLE ·2·78 X10⁻⁴ LB/FT
ORBITAL CORRECTION
MAXIMUM TORQUE DUE TO SOLAR RADIATION PRESSURE · 1·31 X 10⁻⁵ LB/FT
COSMIC RAYS

The forces affecting a satellite during its lifetime are indicated in this diagram from the paper "Dynamics and Engineering of Satellite Attitude Control Systems" by B. Stewart and P. A. E. Stewart of the Advanced Projects Group of Hawker Siddeley Aviation. The operational requirements of an attitude control system, the authors state, include: (a) the correction of launch inaccuracies and turnover programme; (b) corrections required to counteract environmental forces; (c) the requirement to maintain coincidence with moving reference axes (to arrange for torques to maintain an Earth-pointing attitude in elliptical orbits, which is not required in circular, local-vertical-oriented missions); and (d) manœuvres initiated by ground command

sible. But what we did say, and repeat with conviction, was that once we believed that the only solution in this field was a united Europe, the experiences and methods gained by the United Kingdom formed a large part of our common fund of knowledge and it would be our duty to support them and to prevent their dispersal."

In *Space Engineering and European Collaboration*, Air Cde F. R. Banks, chairman of Hawker Siddeley Aviation's Aerospace Technical Services (ATS) Company, maintained that, although the scientist was the key man in astronautics, he should stick to science and let the administrator administrate. Money for space projects should be voted to cover at least a five-year period; and among the possible lines of investigation which could be tackled by Europe was the study of new fuels for launch vehicles and spacecraft—"Recent developments in large solid-fuel rockets are becoming very interesting indeed." The air commodore's reference to scientists was taken up by Mr Weinstein, who commented that scientists did in fact make good administrators in certain cases.

Among the points made by Dr Arnold Frutkin, Director of International Programs, National Aeronautics and Space Administration, in his paper *US Co-operation in Space Research*, were the "guidelines" on which NASA's international programmes were run. He listed these as valid scientific objectives, single-agency sponsorship in each country, full technical understanding before formal agreements, each nation paying for its own commitment, and free availability of scientific results.

The NASA programme, Dr Frutkin emphasized, was "not in any way an alternative to what you are discussing." With the initiation of multi-national regional organizations such as those proposed for Europe and in Latin America, he said, the prospects for broad international co-operation in space research were multiplying. He added: "The United States has welcomed these developments and made clear its willingness to enter into joint projects with the new organizations on the same flexible basis as with individual countries."

Mr A. V. Cleaver, chief engineer (rocket propulsion) of Rolls-Royce Ltd, had presented a comprehensive description of the Blue Streak propulsion system during one of the earlier technical sessions of the symposium, and he returned to the platform on the discussion day, June 28, to outline *The Implications of Not Having a European Space Programme*. One implication was that a large portion of mankind would have opted out of the future of space technology, with the result that the progress of the subject would be retarded. Dependence on US launch vehicles—or those of any other major nation—would mean that our policy was conditional on the continuation of initial agreements, while an independent programme would in fact lead to more effective co-operation between Europe and the USA.

If we opted out of space, Mr Cleaver argued, we might well opt out of other fields for similar reasons. Furthermore, new discoveries in space would trigger associated new developments in other fields. The implication was that, if we were backward in space, we should be backward in other fields. A gradual but inevitable downhill slide for European science, technology and industry would begin.

A film of activities and facilities at the Weapons Research Establishment, Salisbury, and the Woomera range was included in the presentation by Mr H. J. Higgs, WRE Representative, on *Australian Contributions to a European Space Programme*. Australia had said she would make facilities available to a European space launcher organization, if formed, he reported. The first thing she could offer was "another continent," with launching space; and other items included one of the best optical astronomical observatories in the Southern Hemisphere, and ambitious radio astronomical facilities, in addition to Woomera itself. The Australian Government had contributed £80m towards Woomera to date and, for the purposes of the proposed European programme, the base represented a capital asset of £30-60m. Over 4,000 people were employed there.

A number of floor speakers at the symposium queried the wisdom of duplicating US and Soviet work on launch vehicles, arguing that the challenge of space exploration was so big that any limitation of effort would hinder those trying to meet the challenge. Mr Cleaver agreed with one speaker who pointed out that Blue Streak added nothing to propulsion technology which was not already known to the USA and Russia, but described the rocket as "our entry fee into this field."

THE CASE FOR A EUROPEAN PROGRAMME (From the paper by David Price MP)

WE are now in the space age, whether we like it or not. Our public policies, in everything from defence to education, have got to be shaped so as to be able to accommodate the sudden changes in our human environment which will be the natural consequence of a rapidly expanding world. Viewing our affairs from the relative calm of the back-benches of one European Parliament, I begin to doubt whether our leaders in Europe (or their democratic alternatives), grievously over-burdened with the world of today, understand intellectually and emotionally how man's entry into space is already shaping the world of tomorrow.

Mankind is obviously entering a long new phase of exploration and development, comparable to the conquests of the air and of the oceans, but vastly exceeding these in scope. The discovery of Africa and America and the sea route to the East in the fifteenth and sixteenth centuries led to changes in European life so far-reaching as to amount almost to a revolution. How much more revolutionary will be the changes arising from man's discoveries in space. Viewed historically, Europe dare not stand apart from the space race.

At the same time, we have to recognize that no European country can possibly hope to compete on equal terms of expenditure, and diversity of projects, with the USA and the USSR. However, to assume that therefore we in Europe can play no significant part at all in these new adventures would be a complete betrayal of our descendants, as indeed it would be of our ancestors.

Leaving aside the ultimate implications that space exploration will have for the future of mankind, astronautics presents the most severe challenge to applied science and technology. Any nation that contributes to it in an important way will derive considerable benefits, both from the direct technical standpoint (in terms of widespread general advances in technology) and from the accretion to its general power and influence throughout the world.

No one could deny that Russia's success in space has increased her power in the world enormously. Apart from the military benefits of her success, it has established her undisputably as one of the two most advanced countries in science and engineering. Already this has had a marked effect upon her position in international trade.

Basically our decision as to what we in Europe ought to do about space has to be taken in the light of what role we think we can and ought to play in the world of tomorrow. Influence grows from power. Power is indivisible and space is an increasingly important ingredient in power.

What are the possible courses open to European countries? There seem to me to be five:—

(1) Do nothing
(2) Enter space alone
(3) Rely on the United Nations
(4) Co-operate with the USA or USSR
(5) Co-operate with other European countries.

I intend to examine briefly the advantages and disadvantages of these courses.

(1) *Do Nothing*. The whole of my argument to date has been directed towards proving that it would be a fatal error for Europe, as a whole, to stay out of space. I realize that for many countries the economic implications of entering space are frightening. Clearly if they had to choose between taking on so grievous a burden or staying out of space, they would be forced reluctantly to stay out of space. For such countries, and they constitute the majority of European countries, the only way of obtaining a share in space

The symposium was opened on June 26 by the President of the British Interplanetary Society, Dr W. R. Maxwell (far right). Chairman of the first technical session was Dr Theodore von Karman "Flight" photographs

Missiles and Spaceflight . . .

research and space technology is to join together with other like-minded countries in a space consortium.

(2) *Enter Space Alone.* Some European countries may feel that an active space programme is so important to their power and prestige in the world that they must run their own programmes. To any of the major European countries this course has a strong superficial appeal, especially for France and the UK, who might hope to pick up junior partners from within their own national families.

Even for the larger European countries the cost of a minimum space programme, measured in terms of national resources and balanced against alternative demands upon those national resources, would be very substantial. I would not argue that the cost would be intolerable. If the peoples of our countries were so minded the cost of a modest, but still significant, space programme costing up to £25m a year would be perfectly containable within our gross national product. However, such programmes could only be modest, compared with the Russian and American programmes.

The major political problem would be one of persuading the political leaders of the countries concerned to have the courage to spend a substantial sum of public money—small though it would be compared with the major items of public expenditure, such as defence and education—on a space programme rather than on something else of more immediate and popular appeal. Further, they would have to justify their decision to their own electorate. Higher pensions or lower taxes will normally be more appealing to the people than Moon probes or Earth satellites.

Furthermore there would always be those scientists and economists who would argue, probably with some truth, that an undue proportion of the country's scientific and technological resources were being tied up in its space programme and that as a result other important fields of research were being starved of resources.

The positive advantages to any major European country of joining a co-operative venture with other countries rather than carrying out its own space programme can therefore be summarized as follows:—

(*a*) The cost would be shared and therefore would be less *per capita* and hence more acceptable to the electorate.

(*b*) Scientific and technological resources, especially of trained manpower, would be pooled, so that no one country would have to risk denuding other important scientific projects because of the demands of her space programme.

(*c*) No country has a monopoly of scientific and technological talent. The cross-fertilization of ideas that would arise from bringing together space scientists and space technologists from a number of European countries in a joint venture should lead to better results than if these countries supported separate programmes.

(*d*) Politically, it would help to unite Europe. If members of the European Economic Community and the European Free Trade Association were to join a European space consortium, the resulting experience of partnership would help to build that bridge between the Six and the Seven which many in Europe have consistently sought.

(*e*) By Europe entering as one unit, and not as a number of smaller units, the chances of mankind determining to make sensible laws for the regulation of space in time would be increased.

(*f*) If successful, a joint European venture on space would increase Europe's power and hence her influence in the councils of the world.

(3) *Rely on the United Nations.* To some people it might appear that space research should be carried out on a world basis, and not on an individual or regional basis. Since space research represents the exploration of other worlds by the inhabitants of this one, it should for both practical and moral reasons be carried out on a world basis. The only world body available is the United Nations, therefore all space research should be undertaken by the United Nations.

There is theoretical merit in this line of argument, but it does not represent the facts as they are. Two countries, Russia and the USA, are heavily committed to their own space programmes. Why should they abandon them in favour of the United Nations? Even if we wanted them to, would they? In any case the United Nations has never attempted any major research project of this nature. They are ill-equipped so to try.

I see no harm in individual countries or groups of countries carrying out their own space research. Indeed I see substantial scientific merit in such arrangements. The danger to mankind lies, not in separate space programmes, but in an unregulated space race comparable to the race for Africa in the second half of the nineteenth century.

Therefore we in Europe must be prepared to work for a world space law under United Nations control. In my view this object would be assisted, rather than hindered, by a European space consortium.

At the level of basic scientific research we in Europe should encourage a further extension of that international co-operation which worked so well during the International Geophysical Year.

(4) *Co-operate with the USA or USSR.* It has been argued that European countries, either individually or collectively, would be very ill-advised to attempt an independent space programme. Such a programme implies the development of the necessary rocket vehicle to launch its own satellites or space probes. Europe has not got such a vehicle. It would be very costly to develop one and a needless duplication of American and Russian work on space vehicles and rocket systems.

The first flaw in this argument is that there is a European rocket already available to launch a European satellite—the British Blue Streak. The second flaw is the implicit assumption that either the USA or the USSR would be willing to sell the appropriate rockets to Europe. There is little evidence that either of these countries would be willing to sell space rockets to European countries for our independent use. It is true that within a few years the current generation of liquid-fuelled rockets in the USA may be surpassed for military purposes by a new generation of rockets with solid propellants. In such circumstances it might be hoped that liquid-fuelled rockets such as Atlas might be going cheap. Assuming that the USA would be willing to sell such rockets, this would be a very inadequate substitute for the development of a European rocket. Many of the technological and economic benefits of a space programme flow from the development of the space vehicle and the propulsion system of one's own. Riding into space on an American vehicle would be a very poor second-best, but it would be better than doing nothing.

Furthermore, there would be a substantial time lag before such rockets might become available. In the meantime Russia and America would be increasing their lead in space technology. The political advantage of a European space programme would be largely lost by riding into space on an American vehicle. I am of the firm opinion that if Europe is to conduct its own space programme, Europe must have its own vehicle.

An independent European space programme does not exclude scientific co-operation with the USA or the USSR. A number of European tracking stations have been assisting these two countries in plotting the courses of their satellites and their space probes. In my view long-term co-operation can be better effected by Europe having its own independent space programme than waiting expectantly and pathetically for the space crumbs which may fall from the rich man's table.

(5) *Co-operate with Other Member Countries.* Having ruled out partnership with either the USA or the USSR and having established the need for individual European countries to find partners, it seems to me obvious that those member countries who are interested in a space programme should collaborate in a joint programme.

I have shown that the only prospect of entering space for the majority of member countries lies through a joint European venture. I have outlined the reasons why I thought for the larger European countries there are substantial advantages in joining together in a joint programme rather than attempting to undertake their own independently. This is not as revolutionary an idea as might appear at first sight. We have before us the experience of two successful European ventures in scientific co-operation—the European Nuclear Energy Agency and the European Council for Nuclear Research.

The idea of a European programme of space research has been investigated at both the private and Governmental levels.

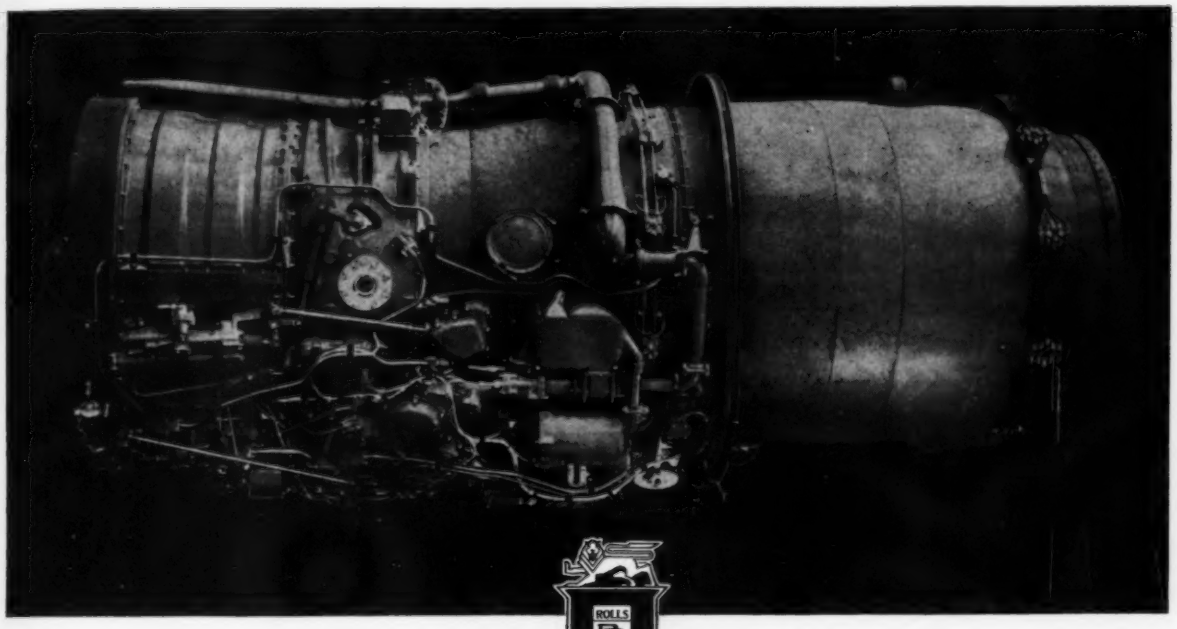
(1) *Council of Europe.* In September 1960 the Consultative Assembly of the Council of Europe, representing the Parliaments, but not the Governments, of 15 European countries, passed the following resolution unanimously:—

"The Assembly . . . recommends to the Committee of Ministers:

1. That they study as a matter of urgent policy the possibilities and cost of setting up a European agency to undertake a space programme, based upon a space vehicle developed and built in Europe, and to promote the peaceful uses of outer space.
2. That they ascertain which member States would be willing in principle to take part in a European programme of space research and the limit of the financial and scientific commitments which each participating State would be willing to undertake.
3. That, if warranted by these studies and investigations, they prepare a specific plan for the creation of a European space agency and submit it to member Governments for early ratification.
4. That any European space agency which they may create should be subject to overall control by a committee of the appropriate Ministers and to the parliamentary influence of this Assembly.
5. That they keep this Assembly informed of the progress made and that this Assembly be consulted as to the future development of this programme."

(*Continued on page 9*)

ROLLS-ROYCE SPEY



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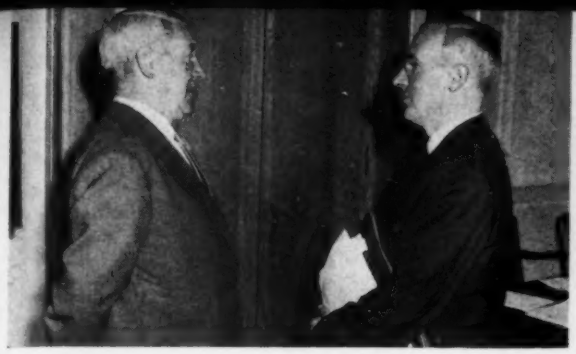


"Flight" photographs

Symposium participants included, from the left, Air Marshal Sir Owen Jones, President of the Royal Aeronautical Society; Mr W. H. Stephens, Director-General, Ballistic Missiles, Ministry of Aviation; Mr H. J. Higgs of the Weapons Research Establishment, Australia, who spoke on Woomera facilities which could be used in a European programme; and Mr J. E. Clegg, also of the Australian Department of Supply

Missiles and Spaceflight . . .

(2) *The Ten-nation Meetings of Scientists.* In the meantime, scientists from ten European countries had met from time to time to consider the possibility of European co-operation in space research. A meeting was held in London in April 1960 at the invitation of the Royal Society. Scientists came from Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom.

The group meeting in London concluded, among other things, that the optical-tracking facilities for satellites in Western Europe were still insufficient and that the special advantages afforded by the large population density and the good knowledge of the ionosphere above Europe should be employed more fully by increasing both the amount and the quality of optical tracking. Consideration was also given to the possibilities of co-operative projects in launching rockets or satellites.

A further meeting of the ten-nation group took place in Paris on June 23 and 24, 1960. At this meeting, Sir Harrie Massey of the United Kingdom was elected chairman of the group. It was decided to establish the secretariat of a study group, which consists of five members, in Paris; Prof Pierre Auger was appointed as the executive secretary.

The five members of the study group were instructed to study:

(*a*) The convening of an inter-governmental meeting to create a preparatory committee charged with investigating the possibilities of establishing a final project for a joint European programme in space research;

(*b*) Terms of reference for a preparatory commission.

(3) *The Geneva Conference.* Consequential upon the work of Prof Auger's study group, an inter-governmental conference on space research was duly held in Geneva, on the premises of the European Organization for Nuclear Research (CERN) from November 28 to December 1, 1960. Eleven countries took part, the ten mentioned above plus Spain, and with Austria as an observer.

An agreement was signed to set up a Preparatory Commission for a European Organization for Space Research. Although the task of the Preparatory Commission will be to "investigate the possibilities of establishing" such an organization, the actual creation of such an organization is clearly the ultimate aim of the governments concerned.

The Preparatory Commission comprising representatives of the 11 nations represented at Geneva held its first meeting in Paris on March 13-14. Sir Harrie Massey was elected chairman and Prof Auger executive secretary. Working groups have been set up to consider programmes for the Organization and to examine legal, administrative and financial matters. The Preparatory Commission held a second meeting in The Hague of May 17-18.

(4) *A European Space Launcher.* There is the further question of whether Europe should endeavour to develop its own space launcher. As I explained earlier, the technological and commercial aspects of space are as important to our countries as the purely scientific.

If we are not involved in the technological aspects of space we cut ourselves entirely from a new, and potentially rich, field of engineering development. With this in mind the British and French Governments convened a conference in Strasbourg to consider their ideas for the development, through co-operation between European states, of space launchers for peaceful purposes.

The Anglo-French suggestions had been discussed previously with delegates from Belgium, Denmark, the Federal Republic of Germany, Italy, the Netherlands, Norway, Spain, Sweden and Switzerland, and observers from Austria, Canada, Greece and Turkey. Delegates expressed keen interest in the political, scientific, economic and technological advantages of such co-operation. These discussions will doubtless assist the Governments concerned in considering their response to the Anglo-French proposals.

The latter provide for the establishment of a European organization having as its first programme of work the development of a three-stage launcher using the British rocket Blue Streak as its first stage, a French rocket as its second stage, and a third stage to be developed elsewhere in Europe. The organization will be empowered to study other projects as the need becomes apparent.

All the member-countries of the organization would be given an opportunity of participating in its scientific, engineering and other work, thus enjoying the scientific and commercial benefits that could arise from a development of satellite launchers for peaceful purposes. It is intended that the work previously done on Blue Streak and the related technology should be put at the organization's disposal for the purposes outlined above. For its part the French Government would also give to the organization the benefit of the studies carried out and investments made in the framework of its national programme.

About £60m has already been spent by Britain in the development of Blue Streak, no part of which would be recovered from any country joining in its further development for peaceful purposes. The estimated cost of a three-stage European satellite launcher based on the existing work done by Britain is a further £70m spread over a period of five to six years, which would be shared roughly in proportion to national incomes. Furthermore, because work on this programme is far advanced in the United Kingdom and because the bulk of the initial work would take place there, the United Kingdom Government is prepared to accept one-third of the cost of the first programme based on Blue Streak.

It is not clear how many of the countries who attended the Strasbourg Conference will declare their willingness to support the Anglo-French proposals. However, a number of countries seem favourably disposed towards the project and it is to be hoped that it will go ahead even though some countries may not find themselves able to participate. I have no doubt that were the Anglo-French proposals to be rejected entirely by all the other countries, which is very unlikely to happen, Britain and France together have sufficient resources to proceed with the project alone. However, on many grounds, especially political, it would be a great pity if this happened.

(5) *Cost.* Any worthwhile space programme must be planned courageously over a long period of time. The American NASA is planning on a minimum basis to ten years. Reasonable continuity in the scale of effort and the provision of finance is essential if scientists and technologists of adequate calibre are to be attracted and if significant scientific investigations are to be undertaken.

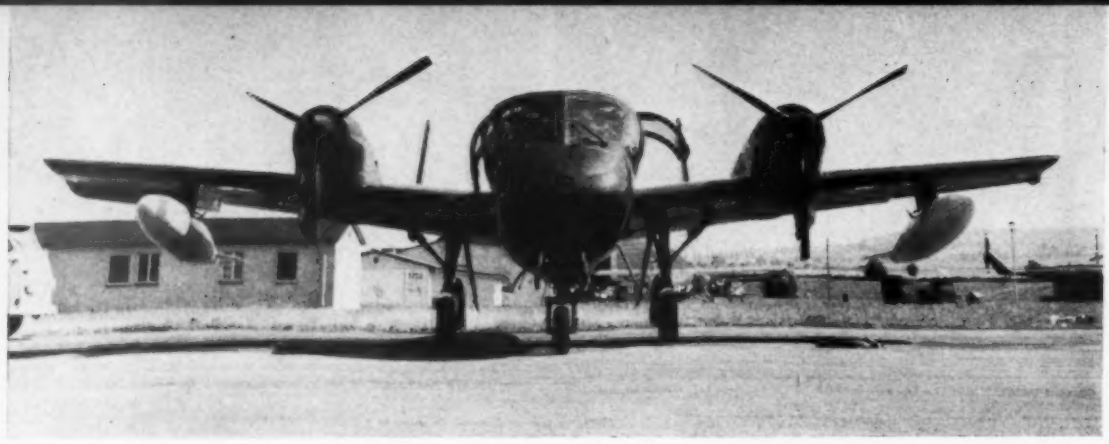
There is a minimum scale of activity below which a space programme would not be worth the effort and resources of member-countries. Therefore it follows that, if member-countries are to collaborate on space research, they must accept a minimum financial commitment as a base load obligation upon their resources, which they would pledge themselves to honour except in circumstances of the direst financial stringency.

Opinion differs greatly as to what that minimum figure would be. For myself, I cannot see that minimum figure being much below £20m a year once a worthwhile programme got started. Initially the figure would be less. Delegates must be under no illusion that there is a cheap way of getting into space, but some ways may be less expensive than others. However, many of us hold the view that after a few years the commercial advantages of exploiting space are certain to be so compelling that further finance would be readily forthcoming. What was the financial return to Spain of Christopher Columbus' voyages of discovery?

Europe must be involved in space. Co-operation between the European nations is the only sensible and economic way of getting into space. Tsiolkovskii, the father of Russian astronautics, once wrote:

> "The earth is the cradle of the mind, but one cannot live for ever in a cradle."

Russia and America have left the cradle. It is time Europe did, too.



GRUMMAN AO-1AF MOHAWK in the Air

BY MARK LAMBERT

No 150 of the series

"Flight" photographs

AEROPLANES are definitely becoming more and more interesting to fly, especially when they pack the powerful punch of lightweight turboprops. The Grumman Mohawk, which dazzled the spectators at Paris, is probably the most unusual of all these intriguing animals and I willingly trekked out to Stuttgart to have a good go at it recently.

Because of its remarkable range of performance, the Mohawk could perhaps be described as two different aircraft hung on a reconnaissance system, with a co-ordinating office up front for two eager humans. With flaps, slats and undercarriage retracted it can attain 258kt in level flight at 5,000ft and fly for more than two hours at 200kt on internal fuel alone. Two external 150 US gal tanks virtually double this endurance. Autopilot, full civil and military radio aids and Doppler radar give the Mohawk all-weather capability and its three alternative reconnaissance systems, camera, high-definition side-looking APS-94 radar or UAS-4 infra-red—fitted respectively to AO-1AF, AO-1BF and AO-1CF versions—can produce pictures which are immediately developed and presented in the cockpit as well as being transmitted to base within seconds. The APS-94 "can spot a motor-cycle moving at 3 m.p.h." Further details appear on page 13.

When the flaps are extended and inboard ailerons come into play, the Mohawk becomes an entirely different aircraft, able to manœuvre with startling ease at speeds up to 20kt below the clean stalling speed and to operate from rough, short strips, for which purpose the undercarriage will absorb sinking speeds of 17ft/sec at moderate weights. The airframe is stressed for 5g positive or 2g negative. During one early test flight, a rudder came off during a dive at 390kt, pushed the elevator hard up and forced the aircraft into a 9½g pull-up. The airframe stayed in one piece and the pilot was able to land.

Ralph Donnell, senior experimental test pilot of Grumman, flew the Mohawk at the Paris Salon and treated the aircraft like an aerobatic trainer, doing stall turns with one engine throttled back, loops and rolls and very short landings. Subsequently he spent his days demonstrating all over the American area of Germany, flying at two or three military airfields every day. At Grafenwöhr, a complete armoured division paraded in 3,400 vehicles and the Mohawk then landed on the ground over which they had rolled. Visits were made to Verona and Vicenza in Italy, for the Southern European Tactical Forces, and the Mohawk was demonstrated to the German authorities at Bonn. For some time the aircraft was based on Stuttgart where it carried out an "orientation program" for the US Seventh Army, with which the aircraft is now stationed. By September there will be 11 US Army Mohawks in Germany, and 31 by the end of the year.

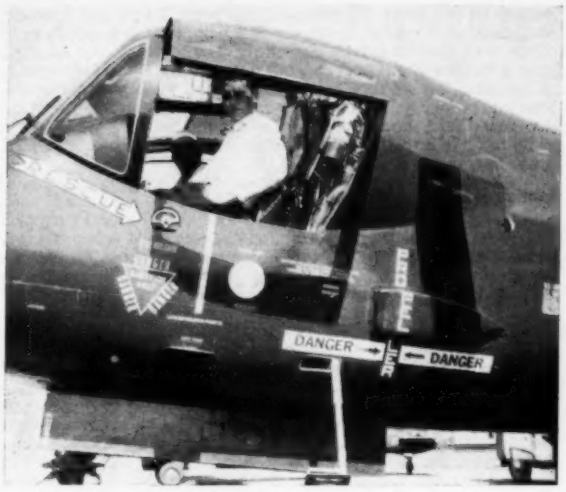
The particular Mohawk I flew was the 57th production machine, completed early in May. Production rate is four per month, approximately half-and-half AO-1AFs and AO-1BFs. There are only two AO-1CFs at the moment. Present powerplant is the Lycoming T53-L-3 free-turbine turboprop giving 960 s.h.p. and 45 e.h.p. in residual thrust. Grumman now propose the T53-L-7 which will give 1,150 e.s.h.p. with only a slight modification to the power egg. In a big export drive now being directed at Germany, the company are also proposing the AO-1EF version with a lengthened and extended forward fuselage housing a large cabin for freight or a variety of additional equipment. Present US Army roles are strictly limited to reconnaissance; but more aggressive applications are implicit in the design, and two pylon strong-points under each wing, a vestigial heritage of US Marine participation in the early days of the design, are still available to supplement the existing tank pylons. The strong-points could take 500lb loads and the tank pylons 1,370lb each. The 5g limit load factor is still available with all pylons loaded and landings with full external load could be made at reduced sink rates. Additional roles then open to the EF version would be target location, target towing, electronic countermeasures and intelligence, missile guidance, chemical, bacteriological and radiological monitoring, training, smoke-laying and freight transport.

An interesting feature is that the AF is a "space and power" machine completely fitted with accommodation and wiring for all the additional equipment required for conversion in the field to BF standard. The different designations therefore relate to the equipment actually installed rather than to ultimate capability.

The US Army are tickled pink with the Mohawk. It surpasses in performance anything they have yet had in the front line and the pilots are mustard keen to get converted. Ralph Donnell certainly did not disappoint them in demonstrations which, in Germany, he made even more enterprising than in Paris. I saw him rolling into a feathered propeller at low level, cruising past at about 60kt looking down at the spectators 30ft below and topping some long zoom climbs with vertical rolls which clearly showed complete confidence in low-speed handling. Just how confidence-inspiring the Mohawk is, I later learnt for myself in some pretty impressive manœuvres. Take-offs with the stick hard back up to 50ft and landings with full reverse thrust were also impressive. I covered the dried ruts from a landing made in very wet ground a few days before in just 80 marching paces. The ruts later went through some sizeable pot-holes as well. An amusing demonstration which represents a deliberate and useful capability, was taxying backwards.

I spent some time with Ralph Donnell, Grumman and Lycoming technicians and US Army pilots as they inspected and serviced the Mohawk and exchanged almost continuous questions and answers. At the same time Ralph showed me the aircraft and explained its many features. The airframe is of conventional structure, but tough, and houses a series of equipment bays fore and aft of the KA-30 camera bay beneath the wing. All internal fuel is held in a single self-sealing tank in the fuselage above the wing structure, by which it is somewhat sheltered against gun-fire from the ground. The crew are also protected by bullet-proof windscreen panels, a ¼in armour-plate floor and steel mesh flak-curtains fore and aft. Outboard fins and rudders, tailplane and elevator sections, main undercarriage legs and the complete power eggs, with cowlings and

Triple fins and rudders, and engines mounted well above the wing, are distinctive features of the Mohawk. The free-turbine Lycoming T53s can be run on the ground or in the air with the propellers feathered



Lambert and Ralph Donnell after the flight. Note the deep, bulged side-windows and numerous inscriptions, one of which refers to the Martin-Baker Mk 5 ejection seats. The extended foot-step below the left-hand danger sign pops out when the other foot-step cover is pressed in by hand

shock-mounts, are interchangeable port and starboard. All control surfaces carry their own angular scales for rigging in the field without special sector boards. De-icing is by pneumatic boots for fins, tailplane and outer wings, by alcohol for the windscreen, by electric mats for the propeller blade-roots and intake rings and by hot air for the intake spokes. Hydraulic wipers and hot-air demisting are provided for the windscreen. Air-brakes, flaps, undercarriage, wheel brakes and nosewheel steering are all hydraulically powered.

Flight controls are largely mechanical, rods and straight cable runs between bell-cranks connecting the pistol-grip sticks and control surfaces. There are duplicated, widely spaced runs to the elevators, which have full-span trim tabs. The ailerons also have trim tabs and are operated through spring tabs. An anti-balance tab has been added to the middle rudder to provide a centring force at small angles of deflection, but a special cable circuit causes the tab to fine off to zero deflection as full rudder deflection is reached. This relieves high forces at large angles. A centring spring is also applied to the rudder pedals, to provide some feel for nosewheel steering. The brakes are toe-pedal operated. A gust lock, which also blocks the throttles, immobilizes rudders and elevator, the ailerons remaining free. Flap control is by shaped lever through a follow-up system with a detent at the 15° take-off position. Any angle can be selected. Undercarriage control is straightforward, with an electric interlock with manual override to prevent retraction when the oleos are compressed.

Systems are quite simple, with a starter generator on each engine and two alternators, together with a battery allowing starting without external power. Fuel is fed through two pumps to both engines from the main tank and external fuel is transferred to the main tank when a four-position switch is moved to the "right," "left" or "both" position. Refuelling is either by gravity or by pressure and defuelling is possible. Float gauges in the external tanks and a capacitance system in the main tank indicate, on one dial, joint contents on a counter or main-tank contents by a needle; individual tanks may be gauged by moving a selector switch.

The Lycoming T53-L-3 engines are most intriguing. The gas producer unit is started by switching on the starter and pressing an ignition button at 10 per cent r.p.m. until the j.p.t. gauge shows the fire has lit. At the 40 per cent idling speed, the propeller turns at 200 r.p.m. if feathered and at 500 r.p.m. in normal pitch. The propeller is an entirely separate unit, constant-speeding hydraulically in the conventional way. Feathering on the ground avoids slipstream and provides convenient braking for stopping rotation. A propeller can even be held still against the side of a vehicle and the gas producer run at 60 per cent r.p.m. while nut shells are fed in to clean the engine. If feathered, the engine and propeller can also be run with the access panel underneath the nacelle hinged down while adjustments are made.

Engine controls sound difficult, but are simple to use. The propeller condition levers govern r.p.m. between the maximum of 1,700 r.p.m. and minimum of 1,100 r.p.m., a good quiet cruising setting being 1,400. If the levers are pulled back past a detent, the high-pressure cocks are closed and a further pull back produces feathering. The normal propeller oil system will take the propeller back to 125 r.p.m. and an auxiliary pump takes over at below 400 r.p.m. to feather or unfeather. The latter is produced only when the feathering latches are removed after pressing a button.

Power levers control the gas producers and work like normal throttles. They have detents at the "military power" setting and at a flight idle and ground idle setting, the former being intended purely to mark the point from which full power can be attained in 6sec instead of 12sec. If the levers are further pulled back and up, the propellers go into reverse pitch and full power is progressively applied. Limiting propeller r.p.m. are 2,200, after which the turbine wheel might shed blades. Power output is principally gauged by torque meters, the allowed maximum of 73lb/sq in being exceeded at sea level only on very cold days. Propeller r.p.m., gas producer r.p.m. and j.p.t. gauges complete the engine instruments. An automatic feathering system, armed by a switch, ensures that the appropriate propeller feathers immediately if more than military power is selected and torque falls below 10lb/sq in.

Cockpit layout is exceptionally good, with clear instrumentation and everything very comfortably in reach. Heating and ventilation are provided, together with gaseous oxygen, but no pressurization, for flight at higher altitudes. The Martin-Baker seats have electric height adjustment, lever lock instead of safety pins and American harness, but are otherwise the standard 80ft/sec, 60kt, runway-level units. Normal ejection is through the roof panels and sliding sun-blinds, but the roof may be pneumatically jettisoned if time permits. Visibility is excellent, particularly down at 20° over the nose and straight down through the side windows.

I flew with Ralph Donnell when the Mohawk had full internal fuel and weighed about 12,500lb with all its 1AF-type equipment. Ralph taxied out using nosewheel steering and turned about one wing-tip. He then switched the steering off and turned about one wheel with brakes alone. The steering is limited (relatively) to avoid screwing a wheel into soft ground by pivoting on it.

Simple cockpit checks included 5° right aileron trim to counteract torque. In the controls I found the typical clunking, springy feel of spring-tab ailerons and a distinct centring feel on the elevators, which also seemed to have some inertia. With clearance from the tower, Ralph lined up and handed straight over to me. I opened the throttles progressively and we began to tear off down the runway. Briefly I noticed that the nosewheel steering was extremely pleasant before we reached 60kt and I began to feel for solid air on the controls. I inched the stick back until we rotated into the air at 80kt without any real feel and settled, as instructed, to climb at 100kt. When Ralph moved the levers, the gear came in with a hefty thumping and the flaps retracted, but only slight trim changes resulted. Reduced to military power we rocketed upwards at 2,000ft/min, with lots of runway still somewhere under our backs. I noted the rate of climb and Ralph applied full power to send us uphill at least half as fast again. The Stuttgart runway was still

The Mohawk AO-1AF cockpit with complete space provision on the right for the side-looking radar of the AO-1BF version. Flight instruments include Collins FD-105 flight system. Engine-starting and fuel controls are in the eyebrow panel and all levers are grouped on the quadrant, ahead of a long, central radio and camera-control console. The striped gust-lock plunger is extended ahead of the throttles. The "bone domes" with boom microphones are normal wear for low-level missions

beneath us at 2,000ft. To prove his first point, Ralph said it would be dangerous, wouldn't it, to pull the stick hard back in this steep climb—and then he did so, vigorously. The Mohawk just sat right up and begged—and juddered, but did not give. There was plenty of vibration, but no real stall developed and we kept going uphill. Normal take-off technique is in fact to hold the stick hard back all the time. When the wheels clear the ground, the tail holds up for a while until it leaves ground effect and the nose comes right up. Pressure is released only at that point.

We levelled off at about 5,000ft and 120kt and I found control forces fairly heavy, but response very good. Ralph now had something to show me. We normally consider an aeroplane first as a glider, don't we? Alrighty. He armed autofeather, reduced power to less than 10lb/sq in torque and slammed the throttles into full power and back, one after the other. Immediately both propellers feathered, but the gas producers continued to idle. So we glided down at 120kt and 1,100ft/min. We could have pressed the unfeather buttons and been under power in seconds, but "We now want to apply more drag, don't we?" The airbrakes were opened with small drag at this speed and a touch of vibration. Rate of descent increased. Next drag stage was to unfeather the propellers and put them into fine pitch for discing drag: rate of descent 3,000ft/min. Gear and then full flap were extended and we then stood on the rudder pedals as we plunged earthwards at almost 5,000ft/min, still at 120kt. The remarkable thing is that no one had touched the stick since we first feathered the propellers. The elevator trim was at one degree nose-heavy. Then, from ground idle, the throttles were slammed open to full power and in what seemed like less than 12sec we had full power and the nose reared up into the climb attitude—still no one touched stick or trim-wheel and the speed remained at 120kt!

I next cleaned the Mohawk up and cruised at moderate power, making 120kt. I could turn with either aileron or rudder alone and the controls were extremely good, if one makes allowance for the distinctive elastic feel of spring-tab ailerons. I noticed that elevator response was slow, so that I could rock the stick and produce a soft rhythmic bouncing up and down, without significant pitch-attitude change. For a while the slow pitch response gave the impression of instability, but stick rate was positive and pitch response was progressive. The delay was really encouraging slight over-control. This all somehow rang a bell in my memory and I later realized that the Mohawk is remarkably like a Meteor to handle, although it has a much better rate of roll. At 120kt, which is well below the normal operational speed of 180 to 200kt, a stall buffet appeared at 1.5g in a turn. In level flight I reduced speed progressively and strong buffeting set in until we lost lift with the nose well up and the stick hard back at 80kt. There was a little aileron in hand and plenty of rudder. Neither wing nor nose dropped—a completely innocuous stall with an unusually strong and early warning. Try as I might, I could not get the Mohawk to stall more firmly.

Speeding up to 190kt, I found powerful control and excellent, fighter-like manœuvrability. It was most noticeable that speed had a considerable effect on directional trim, and rudder correction was required very much in the same way as in a Spitfire. Ralph dived to 250kt and extended the airbrakes. They pulled us back hard and caused a slight nose-up trim change.

Diving speed is 390kt and minimum speed, clean, 80kt. This is already a respectable speed range, but extension of flap brings an astonishing change in the Mohawk. Maximum flap speed is 153kt and application of 15° brings the slats out and cuts in the fully powered inboard ailerons, which droop at 25° with the stick central. Their main purpose is to assist single-engined control by reducing the lift of the wing being blown by the "good" engine, but they also provide remarkable rolling power. Trim changes with flap are small and easily cancelled out with the large trim-wheel.

At 80kt, when I had previously stalled and had very little aileron left, the Mohawk now exhibited fighter-like lateral manœuvrability and no sign of a stall. At the best turning speed of 85kt the radius of turn is a mere 355ft. The aircraft can be thrown around or, for operational purposes, threaded through narrow gaps in obstructed approaches. I pulled back until liberal judder on wing and rudders announced the stall at 60kt. But the nose would not drop and I had powerful aileron and rudder control. Full back stick just would not produce a proper break into the stall, even if I released pressure momentarily and rocked the Mohawk back onto its tail. With full flap the behaviour was just the same, but the minimum speed with power was back to 55kt. Stall warning was very powerful, but behaviour could not have been more innocuous. The elevators still responded slowly and were in fact the weakest control at speeds just above the stall.

Finally we tried single-engined control. Ralph feathered one engine with the Mohawk flying clean at 120kt. I could not tell for some seconds which one had stopped. Trim changes were mostly lateral and a specially big aileron trim-wheel was fitted because of this. VMC with flap is 72kt, and without, 88kt. Best rate of climb speed with flaps is 80-85kt, and without, 135kt. Best angle of climb speed with flaps is 75-80kt. I accordingly set up a full-power climb with 15° flap and gear up at 75kt and 6,000ft, quite high for single-engined performance. Ralph reduced power on one engine and then feathered it. A big heave of rudder and aileron held me straight and I put the nose slightly down to gain 80kt. The Mohawk began to judder and lose height and I applied full aileron and rudder trim with about half travel applied on both surfaces. The judder smoothed out and we began to climb healthily, but I complained to Ralph that the rudder load was too high. Alrighty, apply full rudder, he said. When I did this I noticed that pedal load decreased almost to zero, the anti-balance tab having fined off to neutral. Then he suggested that I try climbing with my feet off the rudder. So I let go, and found that I could climb straight with almost full aileron and no rudder. In fact the Mohawk climbed better with the rudder free and full power on one engine. That is why Grumman were not greatly worried about the high rudder load at the half-way point! I could hold the necessary aileron with one finger-tip. This is really an extraordinary aeroplane. Note that we were then climbing on one engine at about the clean stalling speed, but 15° flap and slats gave full flying capability.

By now we were some way east of Stuttgart and Ralph coupled the autopilot to the appropriate VOR radial. The Mohawk then took itself home with height lock applied, while we rested, adjusted ventilators and fiddled with the height adjustment of the ejection seats. I found that the cockpit was extremely comfortable and visibility excellent. There were two rear-view mirrors for each occupant and sun-blinds overhead to keep off the blazing sun.

Finally we neared Stuttgart and Ralph told me that I would learn more about landing the Mohawk by watching him than by doing it myself. With gear and flap down and zero torque we descended at 3,000ft/min towards a rough grass area near the US Army dispersal. Final approach was made at 80kt with torques varying between 12 and 20lb/sq in and an average rate of descent of 500ft/min. At a theoretical 50ft barrier, Ralph jabbed the stick forward and the Mohawk slowly nosed-over towards the ground. Then Ralph pulled the stick all the way back and, when it seemed that we would hit the ground really hard, he cut the power too. Just when I was waiting for the heaviest of all landings the mainwheels touched the ground and the oleos just mopped up the impact without the slightest jerk. Instantly we were in full reverse thrust and pressed hard towards the windscreen as the 12,000lb aircraft pulled up in under 100yd. It was a staggering performance and the German controller in the tower immediately called and said "You must have a very good undercarriage, Mohawk." Ralph replied that it was a good thing to have, wasn't it. Personally I think the Mohawk is a good thing to have altogether, even at $800,000.

The final demonstration, while I was still sweating from the landing, was to back into our parking slot and then, having applied the brakes, to rock the aircraft gently back onto its tail bumper with reverse thrust. Reason? To test full reverse thrust or change a nosewheel without jacks.

Oh well, it sits up and begs and is as docile as an old four-legged friend. You cannot get on the wrong side of the Mohawk's aerodynamics; but watch out for that reconnaissance and, eventually, strike capability.

GRUMMAN AO-1AF MOHAWK
(Two Lycoming T53-L-3 giving 1,005 e.s.h.p. each)

Span, 42ft; length, 41ft; wing area, 330 sq ft; empty weight, 9,332lb; useful load, 2,646lb; gross weight, without external fuel, 11,978lb; gross weight, with two 150 US gal tanks, 14,337lb; internal fuel capacity, 297 US gal.

Performance *(figures in brackets for two 150 US gal external tanks)*: Design diving speed, 390kt; maximum speed at 5,000ft, 258kt (239kt); reconnaissance mission at 5,000ft and 200kt, 2.07hr and 206 n.m. radius (4.05hr and 404 n.m. radius); ferrying range at 200kt (190 kt) and 20,000ft, 560 n.m. and 2.85hr (1,057 n.m. and 5.54hr); minimum turning radius at sea level, flaps down at landing weight, pulling 1.6g, 335ft (370ft); stalling speed in landing configuration with 10 per cent power, 64kt (65kt); service ceiling, 40 per cent fuel, 25,000ft (24,000ft); rate of climb at military power, 3,235ft/min (2,660ft/min); take-off distance over 50ft, 880ft (1,270ft); landing distance over 50ft, 650ft (675ft).

Ralph Donnell's final demonstration was tail-sitting. He braked the wheels and tipped the Mohawk onto its tail-skid with reverse thrust. In this position full reverse power can be tested and a nosewheel changed without any special equipment

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FLIGHT SYSTEM SURVEY

French Automatic Landing

FROM Geneva, Lear have officially announced that they have concluded an agreement with Sud-Aviation for the development and flight testing of an automatic landing system supplementing the Lear L-102 autopilot at present fitted in Caravelle airliners. For more than a year, various components of the proposed system have been under development in a B-26 at Santa Monica.

The French programme also contemplates the participation of the French company SFENA who will assist in application engineering and flight test work at the manufacturers' airfield at Toulouse. First objective, Lear say, will be the lowering of landing, ceiling and visibility minima, after which the test Caravelle, the second prototype, will be used for actual blind landings. French thoughts on automatic landing, including their proposed use of a Lear system, were first reported in *Flight* on April 20.

No firm decision had then been taken about the exact form of ground guidance to be used, but both existing and proposed microwave systems were under consideration. It is possible that Lear intend to provide safety by ensuring that not more than one axis of control would be put out of action by any one equipment failure, and that the pilot should be able to take over control of this axis at any time during the final approach.

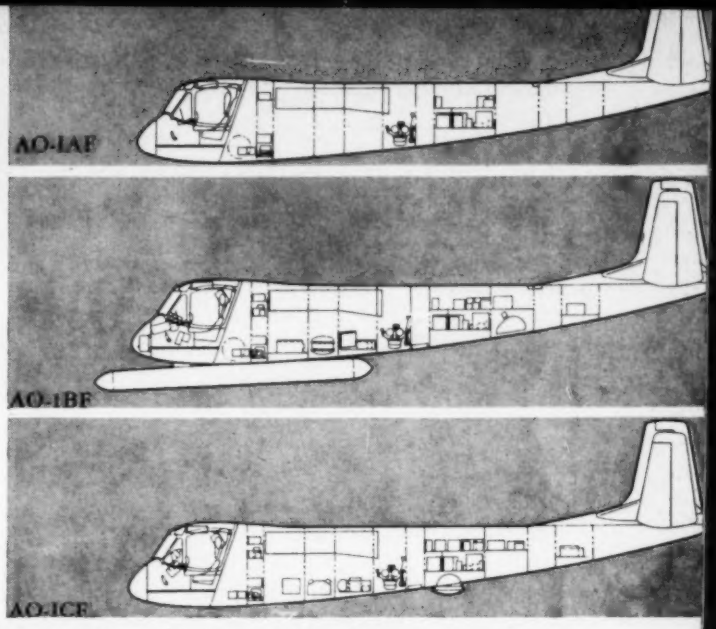
London's Secondary Radar

THE first secondary radar installation in Europe is now nearing completion of initial trials by the MoA at London (Heathrow) Airport. Made by Cossor, the installation is set up on the airfield and aerial rotation is synchronized with a Type 14 Low radar in the SATCC area. A raw display is in a neighbouring trailer but a full decoder and presentation combined with primary radar are working in the SATCC area. In addition, a monitor consisting of a Cossor airborne transponder and GEC equipment counting the number of pulses received every 200sec makes a positive check of performance. Maximum range can be simulated, code responses verified at the aerial site and the side-lobe suppression system, which is working well, can also be checked. The next phase will be operational trials to develop procedures and the equipment can then enter full service. A comprehensive article on secondary radar appeared in *Flight* for June 22.

Equipment for the Mohawk

THE Grumman AO-1 Mohawk, now in service with the US Army, is intended primarily for reconnaissance duties, although it has obvious additional offensive potentialities. As a supplement to the "In the Air" article (pages 10 to 12 of this issue) we include here a description of the very extensive radio and reconnaissance equipment carried in the various versions. Basically there are three equipment standards and the aircraft has full power and space provision, including all cables, for all of them. The inboard profiles on this page indicate the layout of the black boxes.

All three versions, known respectively as the AO-1AF, AO-1BF and AO-1CF, carry the KA-30 camera in the centre fuselage. It is mounted in a rotating housing controlled from the main camera panel in the cockpit so that vertical or 15° and 30° oblique positions may be selected, the cover doors for the appropriate windows being automatically opened. Groundspeed can be set, together with measured aperture and exposure so that the correct settings and overlap are obtained during a continuous run. Alternatively, the AN/APN-118 Doppler, made by Ryan, may be fitted to provide correct and continuous groundspeed measurements for frame timing, as well as navigational assistance. For night photography,



Inboard profiles of the three Mohawk variants, showing equipment layout. The top profile is the basic AO-1AF which carries the following equipment:— UHF and VHF or two VHF radios; ADF and two Tacan/VOR receivers or two ADFs and one Tacan/VOR; intercom., gyro compass and APX-44 IFF; ILS, marker beacon and emergency VHF transmitter; Collins FD-105 director instruments and ASW-12 autopilot; radar altimeter APN-22; ground tracking beacon DPN-62; and KA-30 camera. Full space and power provisions are made for HF radio, IFF coder Mk 12, Doppler APN-118 and the UAS-4 infra-red system. The AO-1BF has this equipment, plus APS-94 SLAR and VHF data link AKT-16, and provision for Doppler APN-129. The AO-1CF normally carries infra-red UAS-4 and UHF data link P/OUAS-4

packs containing 52 upward-firing flares can be mounted above each wing-root to provide a continuous trail of illumination. Photographic capability is, of course, augmented by visual observation from the cockpit. A forward-facing camera may also be installed in the nose.

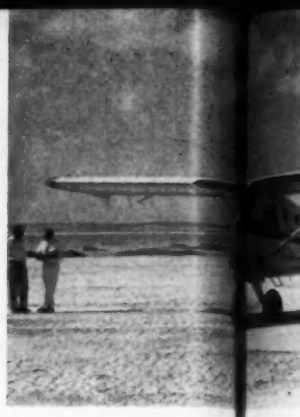
The basic Mohawk carries UHF, VHF and HF communication radios, IFF and coder, ground tracking beacon and radar altimeter, together with autopilot having radio coupling and height lock features. Because US Army aircraft on routine flights frequently fly airways, the Mohawk also carries Tacan VOR, ADF, ILS and marker beacon and stand-by communications radio. According to choice, two VOR and one ADF receivers, or two ADF and one VOR, can be installed. All the relevant control panels and instrument space are provided in the cockpit and only normal blanking plates have to be removed to allow installation.

The AO-1BF has a greatly increased capability by virtue of being fitted with the APS-94 SLAR side-looking radar, the aerial for which is housed in the long external fairing beneath the nose (see centre profile). For this purpose, the viewing and control panels are mounted on the starboard instrument panel and the second set of flight controls is removed. Otherwise the aircraft can reasonably be flown from either right or left seat and all switches and levers are accessible to both occupants. The APS-94 is more sensitive than the APS-87 side-looking radar fitted to some Army L-23s. *Flight* was told that the APS-94 could spot a motorcycle moving at 3 m.p.h. It has two basic modes, general scanning and a moving target mode which cancels relative motion between aircraft and ground, by correlation with Doppler, and indicates only targets moving relative to the ground. These modes can be used consecutively and the resulting picture is displayed in the cockpit for immediate evaluation. In addition, the presentation is intermittently photographed, the film developed within the aircraft and line-scan pictures transmitted to base immediately by VHF data link. The information is therefore available whether or not the aircraft returns to base. Operational tests with the APS-94 have been completed and about half the US Army Mohawks are fitted with it. SLAR has, of course, virtually an all-weather capability.

Very little information has been released about the UAS-4 infra-red reconnaissance system fitted to the AO-1CF Mohawk. Two aircraft have UAS-4 installed in the US. Broadly it is intended as a ground surveillance system in the infra-red and visual wavelengths and has the same immediate inspection and transmission-to-base features, but with a UHF data link. The sensing head is apparently mounted in a fairly small dome beneath the rear fuselage, aft of the KA-30 camera.

The Cossor secondary radar aerial in its mobile housing at London (Heathrow) Airport. The system is now completing its MoA preliminary trials and is said to be performing well

Soon after sunrise the Beaver was prepared for departure from Karachi. In the background is the R101 hangar, which is in process of being dismantled



After 235 miles of over-water fly[illegible]ing was m[illegible] ing Sir Samuel Hoare to Ind[illegible]nded.

Next stop was Turbat, 90 miles inland. These mountains, with their interesting strata, have to be crossed midway between Pasni and Turbat

The stony l[illegible] at Turba[illegible] atures, bu[illegible]quire a n[illegible]

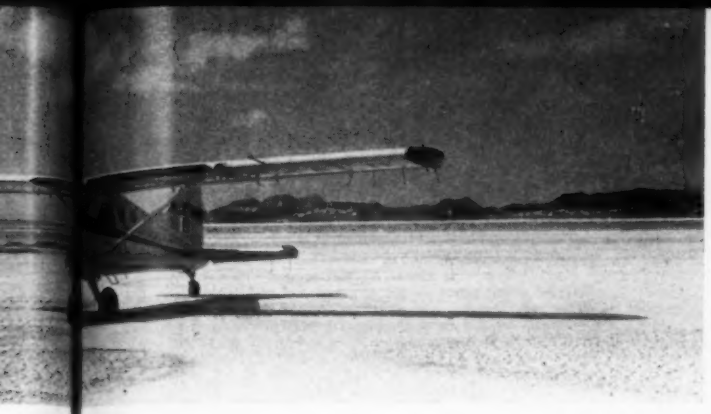
MAKRAN SURVEY

EARLY THIS YEAR PAKISTAN International Airlines began operating cheap-fare Air Bus services in East Pakistan. Plans were made for a network of similar services in West Pakistan and these included ro[illegible] A survey from Karachi into Makran, on[illegible]ade with Persian border. Services were prop[illegible]ant Prote for the linking of Karachi with P[illegible]osed that Turbat, Panjgur, Gwadar and Ji[illegible] operated and DC-3s were to have been [illegible] work h These would have replaced the pr[illegible]ding-gro transport facilities which com[illegible]til new o lorries, jeeps, launches and, be[illegible] These ph Gwadar and Jiwani, camels. [illegible]hn Stroud

The survey party inspected the passenger buildings at Gwadar. These were thoughtfully left by BOAC

Gwadar town, which was Oman territory until recent years, provides plenty of landing areas for Beavers

headland [illegible] except th[illegible]

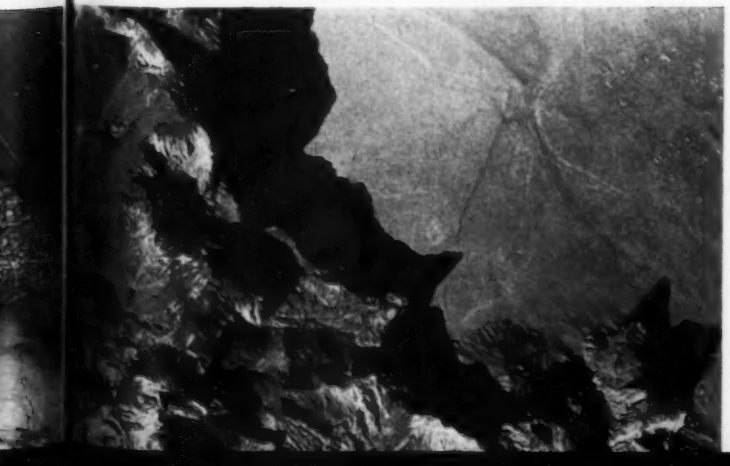


er-water fl ing was made in the desert about 12 miles inland from Pasni, where the DH66 carry- re to Ind nded. In dry weather the ground is baked mud; during the monsoon it is slime

he stony la at Turbat is just about adequate for Beavers in high temper- ures, but quire a new runway which is to be levelled out in the desert

cluded n A survey flight over the routes was kran, on ade with a Government of Pakistan were prop nt Protection Beaver and this dis- hi with P ed that the DC-3 services could not r and J operated until a considerable amount ve been work had been done to improve ed the pr ding-grounds and in some cases ich con til new ones had been prepared. and, bet These photographs were all taken by is. hn Stroud during the survey flight.

headland at Gwadar is typical of the terrain of the Makram except that flat forced-landing areas are not normally provided



Leaving Turbat, houses, huts and compounds passed beneath and then there was more desert and yet more mountains. The headquarters of the anti-smuggling unit is not visible in this picture

At Gwadar the Beaver put down on the old Imperial Airways' landing-ground. Jabal-i-Medhi, better known as Cathedral Rock, forms the background—as it did for so many Hannibal pictures in the 1930s

ATLB's 21st Hearing Continued

"The Great European and Domestic Service Case"

THE Air Transport Licensing Board's 21st hearing might well have been called, CAB-fashion, the Great European and Domestic Service Case. But its real significance at the moment lies not so much in the number of routes, applications and objectors, but in the fact that, whatever the outcome may be, the whole complex issues of pooling and bilateral agreements will have to be thoroughly aired. And it will be surprising if the independents concerned do not take every opportunity to press home the point that pooling and traffic rights restrictionism is not compatible with the health of British air transport as a whole.

CONTINUING his case for British United Airways, Mr Gerald Gardiner, QC, said that the order placed by BUA for BAC-111 short-haul jets was definite—there was no escape clause. In the case of the VC10s ordered, there was a very expensive escape clause in the contract but these aircraft were not in any case due until 1964. BUA felt that a new market might be developed through the use of Gatwick and the facilities at Victoria station.

All these plans represented capital investment. New types of aircraft were necessary in order to keep competitive, but some assurance for the future was necessary to support these commitments.

Mr Gardiner next dealt with the question of diversion of traffic. If there had been a complete monopoly, he said, any change might be argued to be a diversion. BUA maintained that any diversion which might result from the applications being considered would be the least possible compatible with the continued existence of the independents. The independents had built up their services through their own exertions: BEA had stepped in to take a part of the inclusive tour market developed by the independents who now wanted the security which some regular services could ensure. This reminder that the corporations had been guilty of what they have accused the independents—attempting "to reap where others have sown"—was, one feels, a very good point. The corporation would retain all their existing traffic, but the independents wanted a share of the increase, said Mr Gardiner, who then suggested that the Board should consider whether it was desirable to set a term to any licence granted, or limit the frequency at which a service might be operated.

Reverting to the furtherance of the development of British civil aviation, Mr Gardiner said that, whatever causes for bitterness they might find in the past, the independents and the corporations should avoid hostility in the future. They should be guided by the change of policy apparent from the Act of 1960 and remain friends despite the competition between them. The initiative in this had been taken by the chairman of BUA, Mr Wyatt, who had sought meetings with the chairmen of BOAC and BEA to discuss the implications of the Act of 1960, but without success.

The main points of BUA's case, Mr Gardiner said, were: (1) there was a large and increasing amount of travel to the Continent by all means; (2) too little of this traffic was carried by air: (3) services at lower fares had been shown to be possible; (4) developments on the North Atlantic had shown that fare reductions in Europe were overdue; (5) current and future types of aircraft would permit low cost operation; (6) it was better for all concerned that a great many passengers should be carried at lower fares than few passengers at high fares—BUA wanted to reduce fares; (7) there was an increasing market for air travel; (8) the terminal to be built at Victoria station would improve facilities in the UK.

Cunard Eagle Routes

Mr Ashton Hill, for Cunard Eagle Airways, saying how happy he was to follow such a strong opening batsman as counsel for BUA, whose general remarks he endorsed, dealt first with the question of the period of the licence being sought. Cunard Eagle had applied for ten years (1961-71) although the delay in the hearing of the applications and the necessity to wait for the outcome would mean that no start would be possible this year or, possibly, next. They considered ten years a suitable period, however. Secondly, the frequencies quoted in the Cunard Eagle applications were the highest they would operate during the period of validity of the licence; initially the frequencies would be less. Thirdly, Cunard Eagle had asked that the routes shown on their applications be amended to include Gatwick as there had not yet been any ruling as to whether London's two airports were considered to be one for licence purposes.

The financial soundness of Cunard Eagle Airways, and its experience in general, had already been demonstrated to the Board. There would be more evidence on the company's European experience. Documents before the Board showed the routes which Cunard Eagle had operated, in pursuance of the Minister's policy in 1952 to open up new routes—through associate agreements with the corporation—to independent operators.

The monopoly which BEA had enjoyed from 1947 to 1951 had allowed them to choose the best routes during that time. The independents had therefore been at a disadvantage in having to operate new—and presumably less profitable—routes. Eagle Airways had nevertheless attempted the operation of two routes, London - Munich - Belgrade and London - Aalborg - Göthenburg. They had to withdraw from the Belgrade route because the Yugoslav Government had introduced a retrospective 50 per cent petrol tax, and the Gothenburg route had also had to be dropped. BEA had taken over the operation of both routes and Cunard Eagle had been granted rights on the Dinard route in exchange for the service to Belgrade.

Mr Ashton Hill agreed that it was now time to look to the future. BEA, with the advantage of a monopoly in the formative years, had done very well for British aviation. Cunard Eagle, with no scheduled services in 1953, now had a pattern of routes based on 12 transitional licences.

From the days when Eagle Airways (a private company) operated Halifaxes and Yorks they had progressed to Vikings and Viscounts in 1958. Cunard Eagle had operated schedules (not on the best routes) for six to seven years and they had adequate staff and an extensive sales organization. A map (CEA/2) showed the routes operated already and those for which applications had been made, and document CEA/3 was a record of the international and domestic schedules operated from 1957 to 1960.

Mr Ashton Hill agreed with Mr Gardiner that only scheduled services would provide the continuous and secure operation necessary to permit the ordering of aircraft which would allow the company to remain competitive. The applications were to secure this object—they were not attempts to take the cream of the traffic from the routes or to kill the corporation. They were, in fact, for the benefit of the development of British aviation as a whole.

Continuing with the subsections of Sec. 2 of the Act, Mr Ashton Hill said that he would make no comment on 2(2)(b); the Board had already been satisfied on that score. With regard to 2(2)(c), BEA had raised no objection on this score. Cunard Eagle were prepared to pay the rate for the job; their ground staff got the same pay as those of the corporations and aircrew were on properly negotiated contracts. Subsections 2(2)(d), (e) and (f) would be dealt with in connection with the applications for individual routes.

In general the growth of passenger traffic was 15-20 per cent annually, but nobody believed that figures flowed on like Tennyson's brook. The market was affected by the effort expended. It was not for the Board to allow cut-throat competition—they were responsible for the regulation of competition. But competition was beneficial and advances had been made by the independents in pioneering low-cost travel.

Cunard Eagle believed in "dual participation." The routes for which they had applied had been selected with probable traffic in mind: there might be some inconsistencies as the only past statistics for the routes had been BEA's, which had not been available to the independents at the time the applications were made. Competition would benefit the public, and BEA had already assured its success and safeguarded its investments.

Pools had already been mentioned in relation to Sec. 2(2)(g) and BEA had claimed to have obtained the lion's share by pooling agreements—but at what cost? Secondly, only a specimen copy of a typical pooling agreement had been made available by BEA, but a common form of agreement did not exist. The basic form would be modified in negotiation with foreign operators. If BEA were going to put in as evidence, in support of their objections, pooling agreements, then applicants must be allowed to examine the terms and financial consequences of these agreements. Cunard Eagle's degree of investment in European development was £200,000; they therefore came, not as beggars, but asking for an opportunity to partake in the growth of the traffic. Mr Ashton Hill confirmed the views expressed by Mr Gardiner on the desirability of spreading operations in parallel with BEA.

Finally, he touched on the subject of bilateral agreements, remarking that he felt that it was a subject on which the Board should not call for comment, although they had asked for evidence about it. He said that it was accepted that the existence of two carriers of one country might cause inconvenience in this connection, but this inconvenience must be considered with the best interests of British civil aviation in mind, and was a matter on which the Ministry must decide. He referred to the report on capacity restrictions compiled by United Research Inc for the President of the

United States and, with the Board's permission, read extracts.

In any case, he concluded, Cunard Eagle were already operating to Germany, Denmark, France and Italy, which covered seven out of the ten routes for which they were applying. If licences were granted it would then be up to them, as licensees, to negotiate for foreign rights. He submitted that Cunard were competent and fit to undertake the operation of the routes they sought; that dual participation would be in the best interests of British civil aviation and that Cunard Eagle were seeking only a share of the future increase of traffic.

Tradair's Case

Mr Porter then addressed the Board on behalf of Tradair. He said that his company held an operator's licence which had been renewed up to November 1963. Evidence in possession of the Board should satisfy them as to the requirements under Sec. 2(2)(a) and (b). With regard to Sec. 2(2)(c), he was not prepared to give any undertaking that Tradair's terms would be the same as those of British European Airways, but could assure the Board that Tradair staff seemed to be happy, and stayed with them.

Tradair had operated for the first time in March 1958, and had existed for the first year on *ad hoc* charter work with two Vikings, as it had not been the practice of the ATAC to grant licences for inclusive tour flights to a company in the first year of operation. Tradair had survived the second year on a limited number of licences, plus *ad hoc* flights, charters for closed groups, and overseas operations. They had also bought five additional Vikings. At the end of 1959 it was obvious that new legislation, which would favour the operators able to buy newer types of aircraft, was contemplated and Tradair began negotiations for the purchase of Viscount aircraft and bought two in 1960. The company's fleet then consisted of seven Vikings and two Viscounts, all bought without any outside help. There had been further expenditure on conversion of the aircraft and crew training.

When the Viscounts had been bought it had seemed that there might be little immediate use for them, but a large overseas contract and some subcontract work for a BEA subsidiary were obtained.

In 1960 the company had been put on the Ministry list of operators approved for Government charters. Tradair had thus survived in a highly competitive market through its own enterprise and efficiency.

Explaining why Tradair wanted to start scheduled operations, Mr Porter said that the company employed some 200 staff. The future development of the company depended on other people, such as the operators of tours, and on the Board itself. Restrictions

The BAC-111 in BUA livery

imposed by the Board might lead to alterations in the plans of tour promoters and to reductions in the number of flights required. It was never possible to assess until a late stage what were the income prospects of the company. This insecurity was unsatisfactory, and stability could be achieved only through the control over their own activities which scheduled operations would permit.

Tradair had therefore considered the implications of the Act of 1960 and concluded that it was intended to permit a carrier with a new idea to operate in parallel with the corporations, offering a new type of service. Up to now they had concentrated on passenger services on new routes and on a new class of cargo service. This consisted of a service for units of cargo of not less than 1,000kg, with rates based on 1,000kg units, and with no guarantee of shipment within 72 hours. This had permitted high load factors and very low rates which had attracted shippers who wanted quicker movement of bulk consignments than they could get by surface transport, but who did not want to pay the normal air freight rates. Tradair believed that the opportunity to operate this type of service was the assistance which it had been intended to offer the independents.

In the ATAC report of March 31, 1960, Lord Terrington had said that Tradair had shown a genuine appreciation of the need to develop new types of market.

The current applications of Tradair would not undermine the services of existing operators. They were all for a new type of service which, although scheduled, would not be publicly advertised but would be available for block bookings by the inclusive tour agencies, who, with the carriers, had greatly developed this extensive and expanding market. The tour operator was now having to expand his network and open up new areas in order to retain customers. Tradair's nine applications were for schedules which would be available to the inclusive tour operator only. Further expansions of this service would be to new destinations.

It was true that ITX bookings were available on current schedules, but the extent to which they were available depended on the bookings at normal fares; in any case, ITX facilities were open only to IATA-approved agents and many agencies which concentrated on inclusive tours had not IATA approval, as individual bookings were not their normal business.

Seats on the proposed services of Tradair would be available only to (a) normal IATA-approved agents; (b) members of the Association of British Travel Agents; (c) any other agent already licensed by the ATAC or ATLB. The maximum number of seats which could be booked would be a block of six on a Viking flight or ten on a Viscount.

Turning to the possible effect on bilateral agreements, Mr Porter said that application had been made to operate these flights as schedules since there was no other category in which they could be included. They were all for inclusive tour traffic only, however, and were therefore not likely to be considered by foreign countries as affecting bilateral agreements.

Mr Porter's opening address ended the morning session.

Procedural Difficulties

Before the adjournment for lunch Mr Marking had said that he would begin the afternoon session with BEA's general argument on the objections they were making. On the resumption of the hearing, however, he said that the procedure was causing him some difficulty; he could not present a case in objection until the cases in application had been made. Mr Milward's evidence would be mainly in objection. However, since the other applicants wanted the BEA evidence to be presented first, he would suggest that Mr Milward answer questions on BEA's general application as stated.

Mr Milward then went to the witness table and the chairman and the objectors to BEA's applications agreed to Mr Marking asking Mr Milward whether he agreed with what had been said on behalf of BEA the previous day, and whether he produced in evidence the document which had been numbered BEA/50 (the brochure prepared on the occasion of the 15th anniversary of BEA). Mr Milward confirmed that he did.

This constituted Mr Milward's evidence, the substance of which had been written into the record the previous day, and Mr Gardiner was invited to cross-examine on behalf of BUA.

In reply to questions from Mr Gardiner, Mr Milward stated that BEA already held licences for 130 European routes and with those under consideration they would hold 134. It was possible that they might make further pooling agreements. He did not consider that pools constituted a grave economic danger, as had been suggested by Mr Masefield; situations and policies changed. The pool with Air France on the London - Paris route was advantageous to both the corporation and the public, by ensuring profitable load factors. Mr Milward agreed that BEA and Air France held a complete monopoly of the London - Paris route, with the reservation that there were seven 5th and 6th freedom operators on the route, who had limited capacity to offer from time to time. High load factors (quoted by Mr Gardiner as 80-85 per cent) did not mean that passengers were unable to book on the flights on which they wished to travel; excess demand could be met by putting on extra flights.

Mr Gardiner suggested that the pooling agreement meant that it did not matter to either BEA or Air France which of them carried the passengers, and that the beneficial results of competition were therefore eliminated. Mr Milward did not agree and made the point that the re-negotiation of terms of pooling agreements every six months preserved the element of competition. To the suggestion that the public had no alternative, but must accept the standards of service of BEA and Air France, Mr Milward replied that there was the alternative of surface transport, and criticism could be, and was, expressed in the public press and in Parliament.

Mr Gardiner asked whether the high load factors were not due to lack of competition, and Mr Milward replied that load factors on the Paris route had always been high; they were lower on others. Passengers might sometimes have to travel on a later service than the one they wanted. All means of transport suffered from the effects of peak traffic.

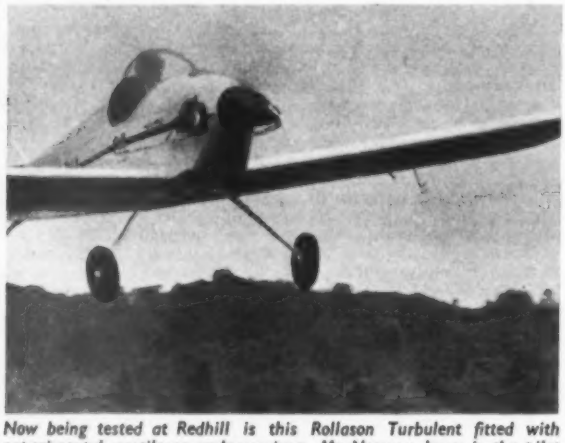
(*Continued on page 26*)

Departing visitors' view of Elstree Aerodrome after the London School of Flying's Pilots' Rally on June 18, reported in our June 22 issue

Sport and Business

THE RECORD FOR ONE DAY'S FLYING by one aircraft set up by the Air Touring Group at Biggin Hill last year was beaten by 600 Squadron Flying Group on June 24, also at Biggin Hill. An Air Touring Auster was flown for 17hr 47min between dawn and dusk on June 16 last year and the 600 Squadron Group set out to beat this achievement in Tiger Moth G-AOES on June 17 this year. Bad weather caused a postponement until June 24, but a team of 27 pilots, all but one flying in pairs, then made 14 trips with seven refuelling stops and logged 18hr 10min. First take-off was at 0330hr and the last landing at 2200hr—an elapsed time of 18hr 30min, leaving 20 min for turn-rounds. First and last refuellings were made in three minutes each, but the other five took only two minutes each. Crews were changed in 30sec or less. The 600 Squadron Flying Group feels confident that this achievement "cannot be bettered."

The Tiger Club's new Stampe (see news-item below)



Now being tested at Redhill is this Rollason Turbulent fitted with experimental cantilever undercarriage. Mr Norman Jones is the pilot in this picture

THE TIGER CLUB has purchased a Stampe SV-4C aircraft, believed to be the first of its type to be imported into this country, and will use it for aerobatic training and displays. The machine was sold by Tricolore Trading Company, London, who specialize in French aircraft and who are British agents for Scintex Aviation.

DURING THE RECENT PARIS SALON, Morane-Saulnier report, orders for 156 Rallye and Super Rallye aircraft were received. The total number ordered as at June 15 was 514, of which 149 were for France and 365 for foreign countries. Of these orders, ten were for 90 h.p. Rallye Clubs, 245 for 100 h.p. Rallye Clubs and 259 for 145 h.p. Super Rallyes. The 27th country to order Rallyes (one complete machine and 80 part-assembled) is Argentina.

MIDLAND SCHOOL OF FLYING at Derby are now training students under the Rolls-Royce works flying scheme, whose members have formed themselves into the Merlin Flying Club. Mr D. F. Naylor has recently joined the staff of the School, which is associated with the London School of Flying at Elstree, as a full-time instructor.

WITH A FLIGHT of 525km from Leszno to a declared goal at Tyszowce on June 20, Mrs Ann Welch set up new British national gliding records for women's goal distance and 500km speed, and completed her Gold C badge with three diamonds. She was attending the Polish national gliding championships at Leszno with her husband Lorne.

LONDON SCHOOL OF FLYING at Elstree now have a waiting list of prospective PPL students, both for full-time and part-time courses. At present 58 student pilots are training for PPL, all of whom have undertaken to complete the syllabus within a period of six months. Including CPL, refresher and instructors' courses, the total now under instruction at Elstree is 84.

A course of 16 students began full-time training at Elstree for their professional pilots' qualifications on June 6, and each is now working for his CPL and either instrument rating or assistant instructor's rating. An integrated syllabus of flying and ground instruction is provided, and these candidates will be taking Ministry of Aviation examinations in November. The next term for *ab initio* students begins on September 19, while candidates with previous experience up to PPL standard will join the course on October 24.

Seen recently at Eastleigh were this ex-Belgian Army Spitfire LF9 OO-ARC (top) and tip-tanked Comanche. The Spitfire was being stripped by Hampshire Aeroplane Club prior to shipment to a Canadian private owner

Henry S. Wingate, chairman of the International Nickel Co of Canada, said recently: "In the UK the company is pressing ahead with the new alloy plant at Hereford . . . it has involved an investment of some £30m." Below, the new canteen

Specialist-alloy Facility

HENRY WIGGIN'S HEREFORD PLANT AND WHAT IT PRODUCES

THIS journal devotes most of its energies to discussions of finished aircraft hardware and how it performs in service; but it is also very much our responsibility to keep an eye on the specialist materials which have been developed for aeroplanes and their powerplants. Of these none is more renowned than the Nimonic family of high-temperature, creep-resistant alloys which, far more than any others, have made possible the development of the modern British gas-turbine aero engine. The vast majority of British military aircrew and airline passengers fly on power provided by turbine blades made of Nimonic alloys, and related products are found in almost every industry in all parts of the world.

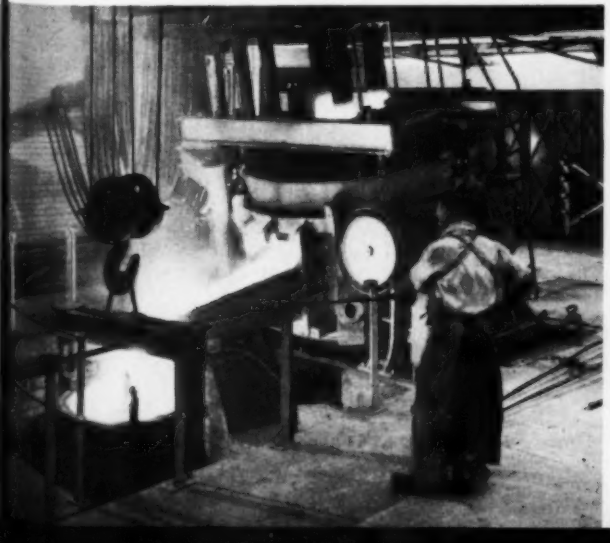
These materials are produced by Henry Wiggin & Co Ltd, an associate company of the International Nickel Co (Mond) Ltd, and in consequence part of a world-wide organization with vast ramifications. For many years Wiggin's headquarters have been at Wiggin Street, Birmingham 16, in a factory which had for long fallen short of the company's needs, on the grounds of both size and age. With the coming of the aircraft gas turbine it became increasingly apparent that Wiggin nickel alloys were of exceptional strategic importance, and during the Korean war the Ministry of Supply decided that a second source would have to be provided. It was eventually decided to construct an entirely new facility on the northern outskirts of Hereford, the ancient and noble city in verdant surroundings near the Welsh border. A more unlikely location for roaring furnaces and giant rolling mills would be hard to find; but here has grown up one of the mightiest single industrial units in Europe, and probably the largest single specialist-alloy facility in the world.

The original factory, which Henry Wiggin & Co designed and built on the Ministry's behalf in 1953, was comparatively small. It was charged solely with the task of producing materials for British military aero engines, and its design output was 60,000lb of Nimonic 80 and 90 bar and 60,000lb of Nimonic 75 sheet per week. The Ministry installed the smaller machines, while Wiggin bought and installed all the heavy equipment, and rented the complete plant on an annual basis.

Intelligent programmes in the general field of public relations overcame the many problems which were bound to arise: "We don't want a great factory, belching black smoke . . . why should I help dad on the farm, when I can be an apprentice at Wiggin . . . how am I going to get labourers, when Wiggin will pay £*x* per week . . . I'm not going to move to Hereford, when all my friends are here in Birmingham (or Glasgow, where Wiggin have another big factory)." In fact, it even took a long time to persuade all of Hereford that the new plant was not engaged in the manufacture of H-bombs. But these are side-issues; and from the beginning it was clear to the company that in the green Hereford fields could lie the solution to their gravest problems.

First, however, they had to buy the plant, and then they had to enlarge it. As the temperature of the Cold War abated, so did the Treasury become more willing to relinquish Government control of strategic production capacity, and in April 1956 sanction was received for the purchase of the whole facility. At that time there was one office building, a laboratory and one production block standing near the middle of a generally flat rectangular site with an area of 52 acres. This was sufficient for a vast expansion, and the company also bought much of the adjacent land. Since 1956 the

Hereford contrasts: left, pouring a three-ton Birlec direct-arc furnace; right, a laboratory engaged in creep-testing at elevated temperatures

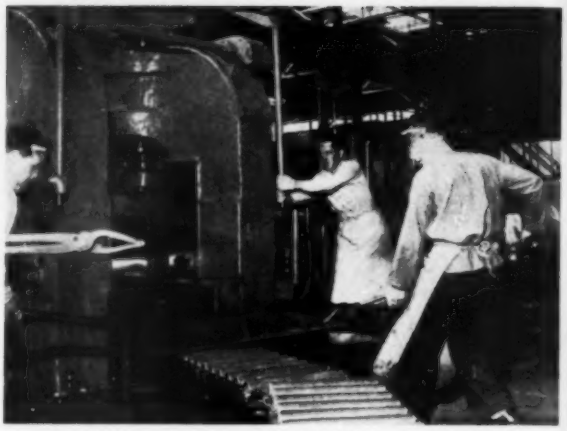


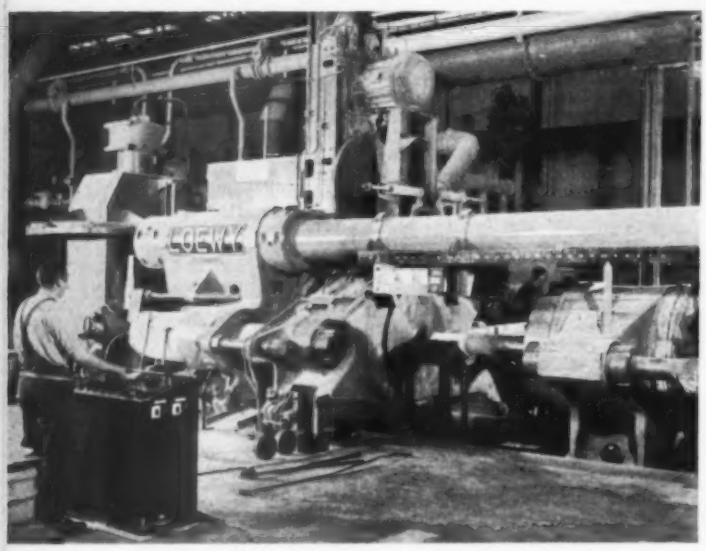
SPECIALIST-ALLOY FACILITY...

plant has grown steadily. Today its covered area is 28 acres, or 1,219,680 sq ft, and employment has reached over 2,000. Current expansion may be gauged by the fact that building expenditure was approximately £3m last year and will be at least £4m in 1961. Completion of present programmes is scheduled for mid-1964, by which time employment should lie between 3,500 and 3,700.

No longer is the Hereford works devoted solely to aircraft products. Only about one-fifth of the total tonnage of raw material sent out from the plant is now destined for aircraft gas turbines; and even excluding the vast output of nickel anodes, the proportion is less than one-third. The chief products are now nickel anodes, Inconel and Monel sheet and strip, and Nimonic 75, 80A and 90, which although originally gas-turbine alloys are now used in many forms in a wide variety of commercial applications. These materials together account for some 75 per cent of the tonnage produced.

Essentially, the Hereford factory is a jobbing unit, for although some basic materials and forms are churned out for years on end, Henry Wiggin & Co would be quite happy to produce 4oz of gold-plated nickel wire—provided the customer was prepared to pay. The range of products is tremendous. Even at the input end of the plant there are 72 basic raw-material stocks for melting and eight for powder metallurgy, in addition to nickel itself. At the output end may be found several hundred specialist materials, in the form of sheet, strip, forged bar, extrusions or wire.





Brute force, but no ignorance: left, glass-lubricated extrusion from a hot billet by the 5,000-ton Loewy press; above, feeding sheet from a furnace to one of the hot sheet finishing stands

In aircraft gas turbines Wiggin nickel alloys are found almost entirely in the hottest portions, where they may well claim to be the ruling structural material. It would be ludicrous to attempt to describe all the bits and pieces of modern engines made from Nimonic or Inconel alloys, but some of the more noteworthy processes may be briefly referred to. In particular, it is clear that the company have been very bold in investing heavily in the extrusion process at a time when the extrusion of most of the more difficult materials had yet to be accomplished.

For example, much of the carcase of a modern engine is held together or reinforced by circular rings having a variety of flanged sections. During recent years it has been found possible to fabricate these rings much more cheaply than hitherto by extruding a section very near to that required and then producing each ring by flash butt-welding. A process that is still in some respects a trade secret (though it was described in our sister-journal *Aircraft Production* over seven years ago) is the production of such rings by the Ugine Séjournet method, in which glass is used to lubricate the steel or Nimonic alloy passing through the die. Using this process, the Hereford plant can squeeze out ring stock in remarkable lengths (plain nickel anode bars are extruded 80ft at a time), and the finished ring sections in Nimonic 75, 80A or 90 cost roughly half as much as when they were rolled from an upset slug of metal. Incidentally, there is practically no difference in u.t.s. between the original bar and the welded ring.

Extrusion and rolling is also the common method for producing bar stock for turbine rotor blades, and the number of Nimonic turbine blades must now be many million. Moreover, airline engines subject to intensive utilization are likely to require reblading at least once a year, and Hereford's output of bar stock for Dart blades is much greater than that needed to support Rolls-Royce's output of new engines alone. It is pertinent to note that many of the latest Rolls-Royce engines, including the Avon, Tyne, Dart RDa.10, Conway, RB.141 and Spey, incorporate air-cooled turbine blading; but although tens of thousands of such blades are in service with many air forces and airlines, no details may be given of their fabrication.

International Nickel and Henry Wiggin spend large sums every year in their quest for ever-better rotor-blade alloys. One of the first to go into production was Nimonic 80, and this is still in great demand for relatively mild applications. First-stage blading was successively produced in Nimonic 90, 95, 100 and 105, and the visitor to Hereford can now see production quantities of Nimonic 115 as the latest blade material. Each of these alloys represents a sustained effort by numerous metallurgists, physicists, engineers and other staffs over a period of many years; and even when the alloy is in production in one form, it may still require extensive research before it can be produced in another (for example, Nimonic 90 wire is now being drawn, after three years' intensive development).

Throughout, the aim is to produce a material better able to withstand physical deformation at elevated temperatures, and so it follows that each new blade material is more difficult to fabricate than its predecessor. Some alloys are workable over a range of only a few degrees, and may require many trips into a furnace and out again between successive operations. Actual blade-manufacture is handled by companies specializing in such work, or by the engine manufacturer concerned; some material makes several trips between Hereford and the fabricator before being built into an engine, and Henry Wiggin & Co follow its progress throughout. Moreover every blade in every engine—be it installed in an Italian Caravelle, an American Friendship or a Peruvian Hunter—can be traced right back to a particular furnace or pot and to a particular heat, and the log-sheet on the melt concerned is kept as a record.

Improved blade material must be reflected in improved turbine discs, and those of the latest engines run so hot that they will be forged in material even better than Nimonic 90. A vast excavation in a new bay at Hereford is steadily being filled with the underground workings of a 1,500-ton Bliss forging press, surrounded by its own furnaces, which will be employed chiefly upon the production of "cheeses" for the manufacture of discs. New procedures have been devised for producing massive ingots for disc manufacture, and on a recent visit to the plant we noticed one of Nimonic 90 with a weight of well over 5,000lb chalked on it. Such an ingot is worth about £7,000.

Process heating throughout the works involves the consumption of huge amounts of butane, supplied from a tank farm on the eastern perimeter of the facility, and steam is fed into the plant by a battery of oil-fired boilers of advanced design. Nearing completion are new process laboratories; and there is a canteen for the needs of the eventual 3,700 employees. The civil-engineering work is in hand on further plant extensions, included in which are additional melting, hot strip mill, and rod and wire mill facilities. Eventually, the original Wiggin Street plant will shut down entirely.

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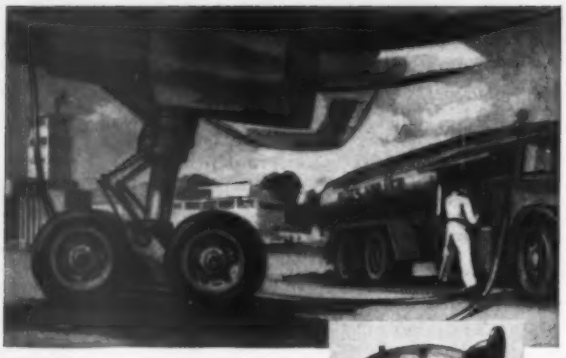

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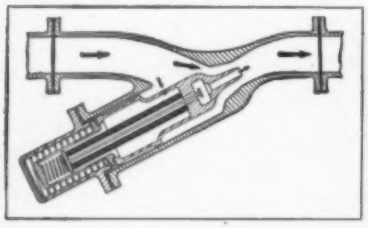

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Straight and Level

"TO an extent which we have no means of assessing, the advent of another operator . . . may generate new air traffic; but there will be diversion, and probably material diversion, from BOAC in the sense that a Cunard Eagle service, if successful, will inevitably carry traffic which might otherwise have been carried by the corporation. Nevertheless, we do not regard this as necessarily a bar to the grant of a licence," says the Board, "because to do so would preclude the grant to any operator of a licence on any route already served by another United Kingdom operator, thus freezing the existing situation on such routes—a result which we cannot believe to have been intended when the 1960 Act was passed."

I am so glad the Board has got that off its chest. Those sterile bogy-words "material diversion" defy rational definition and, like the words "scheduled service," should never have appeared in the 1960 Act. In this respect, the Board's lack of previous air transport experience, which caused concern a year ago, can be seen to have been an advantage: it enabled the members to grasp the basic truth that traffic forecasting is at best an inconclusive business, made still more so by the introduction of abstractions like material diversion.

● I was fascinated by the report in *Flight* that the USAF display at Wethersfield included a LABs demonstration in which the bomb-burst was simulated by a buried 40-gal drum filled with nitro-glycerine, napalm and smoke-bombs (presumably, since "Partners for Peace" was the theme of the display, this represented some sort of ultimate deterrent).

It reminded me of a display I attended a few years ago, when the setpiece—an "enemy ammunition dump"—was about to be decimated by an attacking force of bombers (I seem to remember that they were Tiger Moths). The commentator spent a full five minutes building up the tension, and then the formation came in sight, a good three miles away. At that instant there was a shattering detonation, and flame, smoke, wood and canvas shot skyward.

Was the loudspeaker voice dismayed? Not a bit. "Ektually," it said (it was that sort of voice), "these would be very high-speed aircraft, and they would take the enemy completely by surprise, as we've just shown you."

He probably got a job afterwards with BBC Outside Broadcasts.

● I quote the *Lincoln, Rutland & Stamford Mercury*: "A missile was successfully sent from a launching pad at RAF North Luffenham on Wednesday and safely reached its destination, Vandenberg air base in California, USA."

● Extracts:

(1) "The kite was in use in China certainly as early as the fourth century B.C. . . . From the earliest times, even B.C., there has been a tradition that man-lifting kites were used . . . but it is difficult to establish any facts about them. However, the Chinese were certainly ingenious enough and brave enough to have experimented with them, and may well have succeeded."

(*Charles Gibbs-Smith in "The Aeroplane, an Historical Survey," published by Her Majesty's Stationery Office.*)

(2) "Kite-flying, a favourite pastime among the Chinese, has been banned in certain areas of Hong Kong because it might endanger aircraft landing at Kai Tak Airport. The areas in which the ban is to operate are on the approach path to the airport where aircraft sweep low over the urban district of Kowloon. A Government spokesman, however, reminded the Hong Kong public that the flying of kites at any altitude is prohibited within a three-mile radius of the airport. The Government was particularly concerned with kite-flying near the approaches to the runway, he said."

(*News release from Hong Kong Government Information Services.*)

● Displayed at a recent Boy Scouts' jamborette (*sic*) at Chiswick was this (apparent) Turbulent. A notice read: "This aircraft is an exact, full-size replica, or near enough exact, of a Druine Turbulent and the following materials went into its construction: 5lb of one inch nails; 15 sheets of thin plywood; 400ft of wood; one gallon of paint (free); 6lb of self - raising flour; 16ft of conduit; 3 doz copies of *The News of the World*; instruments & windscreen by courtesy of Rollason Aircraft & Engines Ltd; propeller by courtesy of Fairey Aviation Ltd; wheels on loan; plus 5,000 man hours of work by the scouts, senior scouts, scouters and ex-scouters of the Sixth Brentford Air Scout Group. Total cost £8 10s 6d."

I thought you would like to meet the famous French aeronaut Count Henry de la Vaux in his survival suit. This is another picture from "The Autocar" archives and bears the date September 21, 1907. The original caption reads: "A French aeroplanist ready for flight or a fall"

● Those whisky bottles at London Airport have been described in the House of Lords as "an architectural outrage" by Lord Conesford, who has demanded their immediate removal. "Why did the Government," asked Lord Conesford, "employ a distinguished architect like Mr Gibberd to design the building and then disfigure his work by such an architectural outrage?"

But it was the following exchange that nearly made Uncle Roger reach for his hip-flask:

Lord Conesford: "Mr Gibberd is a member of the Royal Fine Arts Commission and is outraged by what has been done. Can we have the name of the firm of consulting architects who approved?"

Earl Jellicoe: "I do not know whether I should disclose this, but the firm was Mr Gibberd's own firm." (Laughter.)

ROGER BACON

Queen's Physician

IT was announced last week that AVM S. R. C. Nelson, OBE, MD, MCP & S, has been appointed an honorary physician to the Queen. He has been principal medical officer of Bomber Command since October 1959, and previously held the same post with Technical Training Command. A Canadian, AVM Nelson joined the RAF Medical Branch in 1935.

Vulcan of 617 Sqn (a modified Mk 1) being refuelled by Valiant tanker of 214 Sqn

SERVICE AVIATION

Air Force, Naval and Army Flying News

First Wessex Squadron

ON Tuesday the first Wessex anti-submarine squadron, No 815, was being commissioned at RNAS Culdrose. The CO is Lt Cdr A. L. L. Skinner, and this new role continues a famous history which in war included the attack on the Italian fleet at Taranto and the Battle of Cape Matapan, actions in which the squadron's Swordfish achieved considerable success. Its aircraft bear a harp insignia, reminiscent of many years spent at RNAS Eglinton in Northern Ireland.

Entente Cordiale

RECIPROCAL visits are being made this month between the RAF Central Fighter Establishment at West Raynham and the Centre d'Experience Aeriennes Militaire of the French Air Force at Mont-de-Marsan. Gp Capt D. Crowley-Milling is leading the CFE officers on their visit to France from July 17 to 22 and the commandant of the CEAM, Col F. Maurin, leads the French visitors to West Raynham from July 24 to 28. The RAF officers are to fly in Mirage, Mystère and Vautour aircraft, the Frenchmen in Hunters, Javelins and Lightnings.

"No Other Aircraft . . ."

IN a recently published brochure, *The Beverley in Service*, Blackburn Aircraft mark the first five years' service of Beverleys with the RAF, commemorating the delivery in the spring of 1956 of the first of 47 of these aircraft which have since gone into operations all over the world. In photographs and text the work of these ubiquitous machines is described, from carrying City of London state coaches to Helsinki, to air-lifting troops, vehicles and stores from Cyprus into Jordan; from flying a Folland Gnat to Aden to heavy-dropping of equipment on parachute exercises in the Far East.

Beverleys are now in service with five squadrons of RAF Transport Command and the previous AOC-in-C, Air Marshal Sir Andrew McKee, said of the aircraft: "The Beverley has given an entirely new significance to the term air-portability, as its huge freight compartment literally opens the doors to a vast new range of service equipment and military stores which hitherto could not have been carried by air." As Blackburn Aircraft comment, "No other aircraft . . ." is a phrase "heard again and again" in reference to the Beverleys.

SHAPE Post

A NEW appointment has been announced for Air Cdre B. E. Burt-Andrews, CBE: from January next year he becomes United Kingdom national military representative at Supreme Headquarters Allied Powers Europe. Since October 1958 he has been first commandant of the Pakistan Air Force staff college in Karachi, which was modelled on the RAF staff college at Bracknell, Berks.

DC-8 Behind You

"YOU are No 2 in traffic to a Boeing 707 on finals. Expedite clearance from the runway as there is a DC-8 immediately behind you." This is the sort of RT instruction heard by pilots of No 28 Sqn, flying Venom FB.4s at Kai Tak, Hong Kong's international airport. It last year handled 6,000 airliners carrying 200,000 passengers and is also used not only by the RAF but also by the Hong Kong Auxiliary Air Force. The latter unit, believed to be the Commonwealth's last auxiliary flying squadron, operates Widgeon helicopters (supplied by the Government) and Austers. The helicopters make possible a regular "flying doctor" service to remote areas and islands; it also co-operates with the police on crowd control and with the civil aid services.

Another flying unit at Hong Kong is No 20 Independent Reconnaissance Flight of the Army Air Corps, based at Shatin airstrip. RAF Kai Tak is commanded by Wg Cdr R. C. Rotherham and the Royal Air Force at Hong Kong is administered from air headquarters in Victoria by the AOC, Air Cdre P. L. Donkin.

Henlow Commandant

AN ex-apprentice, Air Cdre J. C. Pope, CBE, is to be AOC and Commandant of the RAF Technical College, Henlow, Beds, from July 31. He is at present STSO at Flying Training Command headquarters. His predecessor at Henlow, Air Cdre N. C. S. Rutter, becomes STSO at Bomber Command headquarters from August 21 as an air vice-marshal.

IN BRIEF

The Queen is to present a standard to No 120 Sqn at RAF Kinloss on August 14.

RNZAF crews are undergoing DC-6 conversion training at Whenuapai.

No 8 Flying Training School, RAF Swinderby, Lincs, is to close.

An illustrated brochure, *No 92 Squadron Aerobatic Team*, has been published by the Air Ministry.

Three Hiller 12E helicopters have been ordered for the RCAF. They will be used initially as trainers.

Fg Off David Jamieson received the three major trophies at a passing-out parade at No 2 Air Navigation School, RAF Thorney Island, on June 14.

The summer 1961 edition of the *RAF Athletic and Games Handbook* has recently been published by the Royal Air Force Sports Board, Air Ministry, London WC1, price 4s.

Staff and students of the RAF Flying College, Manby, Lincs, are visiting the RCAF and USAF. The students are members of No 19 Specialist Navigation Course.

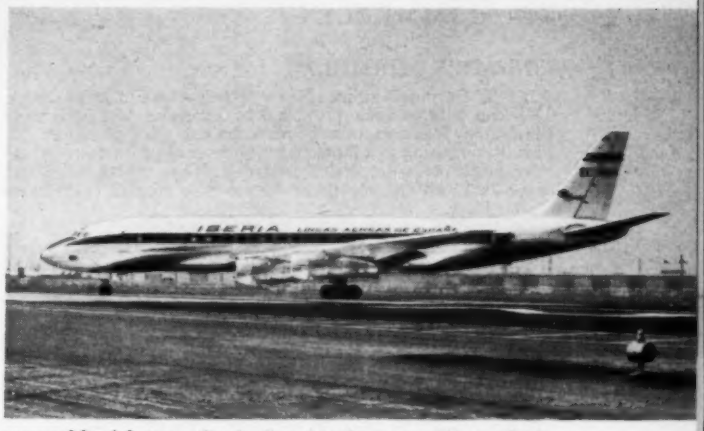
The Air Minister, Mr Julian Amery, said in Parliament recently that Transport Command expected to take delivery of five Comet 4s next year and also of "a substantial number of Argosies and helicopters."

The Prime Minister is to unveil the statue of Marshal of the Royal Air Force Viscount Trenchard in Victoria Embankment Gardens, outside the main Air Ministry Building, on July 19.

The AOC No. 1 Group, Bomber Command, AVM J. G. Davis, recently inspected Avro Blue Steel production at Woodford. He was shown round by Sir Harry Broadhurst, managing director, and Mr A. Stewart, director and assistant general manager, missiles.

Five pilots and five observers of the Royal Australian Navy are to train in the UK in helicopter anti-submarine techniques with the Royal Navy, in preparation for the conversion of HMAS *Melbourne* to an anti-submarine role in 1963. They are to form the nucleus of a new helicopter squadron in Australia and will provide the initial staff for the anti-submarine helicopter school at Nowra.

Members of Liverpool UAS with the DH Trophy after defeating Birmingham, Liverpool, Manchester and Queen's (Belfast) Air Squadrons at Woodvale on June 24. Left to right, Cdt Plt J. B. Wrench, Actg Plt Offs P. J. Harris and J. Ambler, Flt Lt J. Shelton (instructor) and Cdt Plt D. A. Wilding



First turbofan-powered DC-8 series 50 for a non-US carrier, this example was recently delivered to Iberia, who started jet services to New York on July 1. A DC-8 series 50 destined for KLM flew non-stop from Long Beach, California, to Rome on April 21-22, covering the 6,894 statute miles in 11hr 17min

AIR COMMERCE

A HIGHER PROFIT FOR BEA

FOLLOWING a meeting of the Board of BEA, Lord Douglas announced that the profit for 1960-61 was higher than originally estimated. "I am happy to say that on a final review of BEA's annual accounts we have made a profit of £1,540,000, a quarter of a million more than I forecast some time ago," he said, pointing out that this was the net profit after payment of £1.3m interest on capital. BEA's little 15th anniversary leaflet, published recently, gives some of the salient facts of how the corporation has grown, and speaks of "the passionate concern of all levels of BEA to maintain BEA as a lean, dynamic airline." A note on BEA's plans for a new very-low-fare rate on the domestic route London-Glasgow/Edinburgh appears on the next page.

AMERICAN CARRIERS GET TOUGH

BOTH PanAm and TWA have filed complaints with the Civil Aeronautics Board that two major European carriers—KLM and SAS—are exceeding the rights granted in their foreign air carrier permits and the relevant bilateral agreements. Substance of the charges is that the Scandinavian and Dutch carriers are scheduling excessive capacity and thereby attracting traffic from outside their home countries which PanAm and TWA consider is rightly theirs. TWA describes itself as "adversely affected by KLM's operations . . . particularly its operation to and from New York," and considers that KLM's schedules, sales promotion, advertising and origin and destination of passenger traffic reflect increasing concentration on traffic which is "rightfully" that of TWA and PanAm; KLM's frequencies, it is felt, grossly exceed traffic demands between Holland and the USA, and TWA feel that the CAB should do something about it. The same charges are made in respect of SAS.

As is well known, the Americans have always shunned predetermination of frequency and capacity—at least until recently, when the CAB has developed a more protectionist attitude in defence of US airlines, who have for several years now been vociferous in their complaints at the traffic rights granted to European carriers, particularly on the West Coast. Now, as detailed on pages 910-11 of our June 29 issue, the CAB is proposing to regulate the frequency and capacity of foreign carriers operating into the USA; and complaints by the two major US international airlines about KLM and SAS will put the principles of the Bermuda Agreement to their severest test to date, especially when it is recalled that, unlike many other European nations, the Scandinavian countries and Holland have, like the Americans themselves, consistently championed freedom of the skies.

PanAm considers that the SAS violation of its foreign air carrier permit is long standing, and that by concentrating transatlantic services on Copenhagen, SAS is operating services between the whole of Europe and the USA using the Danish capital as a gateway. *Interavia* quotes the following figures given by PanAm in support of its charges:—

SAS carried 91,906 passengers to and from New York in 1960, of whom only 44,115 (48 per cent) were US-Scandinavian passengers. The 1959 and 1958 percentages were 47.9 and 48.23.

SAS operated an average frequency of 8.4 round trip jet flights a week to New York from November 1, 1960, to April 30, 1961, but this figure is now 19.2 per week. In the first four months of 1961 the SAS load factor was only 42.3 per cent. Capacity had been increased by 65 per cent but traffic was up only 30 per cent.

SAS had a load factor of only 30 per cent on its Los Angeles route in the first four months of this year. Capacity was up 84 per cent but traffic only 27.5 per cent. In 1960 SAS carried 29,624 passengers to and from Los Angeles, of which only 13,568 (45.8 per cent) were US-Scandinavia passengers. Even allowing for bona fide stopover traffic (1,044 passengers) the carriage of third-country traffic, PanAm feels, was clearly excessive. On the basis of these figures, PanAm feels that the SAS New York traffic in the first four months of this year could have been accommodated on an average frequency of only 3.7 round trip flights per week, and 9.3 per week would suffice for the summer season at SAS's 1960 seasonal load factors. On the Los Angeles route, 1.7 round trips per week in winter and 2.6 in the summer would have been enough. So the CAB, on the basis of such figures, might have to consider cutting present frequencies by perhaps half.

TWA FOR TWO

IT is no coincidence that 1960 saw the adoption by TWA of a new insignia—two interlocking hemispheres cut horizontally in TWAin by the familiar red block initials—for, in the chairman's introductory word to the annual report for 1960, "You can be certain of one thing: TWA is in the international business to stay."

A few years ago it would have called for unusual courage to have given shareholders such an assurance, for some outside observers felt it was only a question of time before TWA's backers tired of seeing their airline's resources being eroded by the Atlantic. But by 1960 the wheel of fortune had turned full circle and only a startling 35 per cent expansion of international revenues allowed the company to weather a pre-tax loss of about $1m on domestic services.

The paucity of statistical information in the report—particularly regrettable in the case of an airline of the size and status of TWA—makes it difficult to undertake an intelligent appraisal of this remarkable transformation. It is, for instance, impossible to tell to what extent the benefits of an overall reduction in unit costs of 7.5 per cent, or the penalties of an overall drop in load factor from 63 to 54 per cent, have been variously divided between domestic and international operations. Indeed, only one main trend can be clearly established—that all or most of the revenue improvement was due to the higher proportion of traffic which moved at the high rates prevailing on TWA's international stamping-grounds. Thus, at a time when the volume of total traffic was virtually unchanged, revenues rose by 9 per cent. The relatively high tariffs on the international routes is shown by a yield on these routes of almost one-third of total revenues, whereas international traffic was only about one-sixth of the total.

By European standards, the volume of the company's business in 1960 was colossal—5.8 million passengers, 5,660 million passenger-miles, $378m operating revenues, $362m operating expenses. But perhaps the most startling item in 1960 was the increase shown in this one year against fixed assets—$189m. Part of this extraordinary figure arises from the delivery of new Boeings and Convairs; but the principal explanation is to be found in the fundamental metamorphosis of TWA from an airline renting aircraft from Hughes Tool Co to an airline with its own fleets. This has only been accomplished by a matching increase in capital: although the share capital remained unchanged at $33m, the long-term debt shot up from $33m to $223m. Even this story is incomplete, for at the close of the year under review the financing process was not completed. The full picture is likely to be apparent at the end of this month, when total long-term debt is expected to reach $265m spread among two insurance companies ($93m), nine banks ($72m) and a $100m debenture issue, over three-quarters of which will be held by TWA's controlling shareholder, Hughes Tool. Finally, a revolving credit of up to $50m is available, if required, from Hughes. Until 1970—or earlier if the insurance companies and banks are repaid by then—the Hughes controlling share of the ordinary stock will be put in trust. During this period virtually all the flight equipment will be mortgaged.

To get this money, TWA has had to pay a stiff price (6 per cent to the banks, 6¼ per cent to the insurance companies). These loans were negotiated too late in 1960 for interest charges to figure significantly in last year's accounts. But from now on TWA will have to stand an interest charge to insurance companies and banks of over $7m annually. To meet these payments, and the return expected by shareholders and debenture-holders, TWA will have to get the best of both its two worlds.

AIR COMMERCE . . .

FINNAIR'S FORMULA

MOST European airlines find that their intra-European services can only be made profitable by arranging pool agreements which allow load factors to be hiked up into the high sixties. Yet Finnair, operating to a large extent on its own on an economically inhospitable network, and consistently failing to fill its aircraft more than half full, continues to return a regular profit to its shareholders.

Examination of the company's recent annual report for 1960 reveals that the secret of Finnair's formula is high staff-productivity. It is probable that no airline outside the US does so much short-haul business with so few staff as does Finland's national carrier. In 1960 the company's 1,413 employees extracted an output of 36m c.t.m. from their fleet of three Caravelles, six Metropolitans and nine DC-3s, equivalent to an average rate of about 27,000 c.t.m. per employee over the year. For an airline with an average passenger-haul of only 272 miles this is quite remarkable. Another index which reflects the economic use of manpower is the relationship of salaries and wages to total costs; whereas most European airlines show a proportion of about one-third, in the case of Finnair the proportion is as low as one-quarter. The airline's success in keeping down staff costs apparently results from the exercise of rigid control over recruiting, coupled with extensive resort to sub-contracting.

Another factor that helps Finnair in attaining solvency is an above-average revenue rate. On its international services this is because of the relatively high levels at which overwater fares are pitched in northern Europe. Domestic services, on the other hand, are believed to be subsidized, but no hint of this is given in the annual report.

Bearing in mind the effect on capacity on introducing three Caravelles into such a small fleet, the company's ability to retain load factors at the 1959 level of 47 per cent was highly creditable. This was only achieved by a 38 per cent increase in traffic. Because of the greater emphasis on high-rated international traffic, revenue increased even faster—by 43 per cent. This growth took Finnair's passenger total over the half-million mark for the first time—the 1960 figure being divided into international scheduled services, 186,000; domestic scheduled services, 310,000; charter services, 20,000. Because of the longer passenger haul on the international services (425 miles as against 181 miles on domestic routes), this class of traffic yielded the bulk of Finnair's revenues of Mk 4,117m in 1960.

The major problem facing the airline continued to be the high seasonal variation and low density of traffic on its services. Despite Finnair's concentration on a restricted network—unduplicated route distance only 8,000 miles (international 5,200 miles, domestic 2,800 miles)—the average loadings were only 27 passengers on international services and 19 on domestic services. These low figures reflect Finland's lonely situation off the air tracks of Europe. The country's enterprising efforts to stimulate tourism, and the closer integration of the national economy into Western Europe, will both lead in time towards a thickening of Finnair's routes. In the meanwhile, however, Finnair is showing how to make the very best of a bad job.

Pilot on the Carvair's maiden flight, recorded in our issue of June 29, was Mr D. B. Cartlidge (left), one of Aviation Traders (Engineering) Ltd's two senior pilots. Captain R. Langley (right), managing captain of Channel Air Bridge, acted as first officer and standby pilot

TWOPENCE A MILE TO SCOTLAND

BEA intend, subject to ATLB approval, to offer off-peak fares between London and Scotland this winter that are cheaper than the existing second-class rail fares (although British Railways do run special excursions at lower rates). BEA's proposed fares to Scotland are £3 3s single and exactly twice that amount return; the corporation claims that these are the cheapest scheduled air fares in the world. A second-class single rail ticket to Glasgow costs £3 12s, and a shilling less to Edinburgh; average rail time to Glasgow is eight hours. BEA's 139-passenger V.953 Vanguards will leave London (Heathrow) nightly at 11.40 p.m. and arrive at Renfrew 85 minutes later, flying on to Turnhouse Airport, Edinburgh. The new fares are a pound cheaper each way than existing rates, and the passenger will be able to fly back any night without his ticket being subject to excursion date restrictions.

BEA's announcement is well-timed politically, for the corporation can present a strong case to the Board that independent competition on domestic routes (Cunard Eagle has applied for Edinburgh and Glasgow) will jeopardize the public's chances of being able to travel cheaper than by rail. Last year's Select Committee report on British Railways made the interesting point that the average number of passengers per train has ranged from 102 in 1948 to 91 in 1950, and was 98 in 1959, or in other words a good Vanguard load. Dr Beeching had better take a good look at how the French have solved the problem of rail/air competition with Air Inter if he does not want British Railways to suffer from air competition to the extent that the American railways have done.

UP-TO-DATE WITH RIDDLE

RIDDLE AIRLINES, INC, which not so many months ago was in poor financial shape—almost certainly the only carrier in the industry to have described a year's financial results as "lousy" in a report to shareholders—is now well on the way to prosperity following the award of military contracts totalling $15,410,679. These contracts, running from July 1, 1961, to June 30, 1962, provide $7,571,180 for Logair work with Argosies, $3,329,991 for similar work with C-46s, $4,290,008 for MATS international work and an Alaskan C-46 fuel contract worth $219,500. Riddle's Argosies and DC-7Cs are now flying to Japan, the Philippines, Alaska and across the Atlantic on contract charter work and to Puerto Rico, the US east coast and the mid-west. A net profit of $90,000 was made in May, and current efforts are directed towards getting a more economic route structure.

The Domestic Cargo-Mail Service Case, now three years old, is expected to be settled at any time. From it Riddle hopes for a permanent certificate, operating rights in the New Orleans, Birmingham, Atlanta and New York markets, cargo service from Atlanta to Los Angeles and San Francisco and eligibility for subsidy. Further markets in Latin America are expected from the proposed merger with Aerovias Sud Americana Inc (ASA International Airlines), which serves Central America, Colombia and Ecuador. ASA's chairman, F. S. Buchanan, has testified that if the proposed merger with Riddle is not approved ASA would probably be unable to continue common carriage operations, and "it appears that with ASA's limited resources it would not be possible to stem the recurring losses which are being sustained from the operations between Florida and Latin America." The withdrawal last August of permission for ASA to serve Guatemala City had been a big blow to ASA's financial position. ASA had also been troubled by changes in management which had proved detrimental to the company's operations.

CUTTING THE RED TAPE

PERHAPS the world's least troubled tourists, according to IATA, are Europeans travelling in Western Europe and the United Kingdom. Almost all their governments, either individually or through such groupings as Benelux and the European Community, have now reached reciprocal agreements dispensing with visas for one another's citizens. IATA considers that this year's tourists will have less trouble with government red tape than at any time since the war.

This country has now waived visas for about 54 nations. Japan has simplified entry formalities for 16 countries by similar means, and currency declaration forms have also been dispensed with. Brazil is the first South American country to do away with the passenger manifest, and she has accepted the standard Embarkation/Disembarkation card for passengers.

As Sir William Hildred has said, "The best argument for less red tape is the overwhelming logic of steadily increasing traffic. No government agency can hope to handle the masses of tourists which we are carrying in the jet age by old-fashioned processing methods and documents which date from the days of the quill pen."

Carlisle's municipal airport at Crosby was officially opened recently by the Mayor of Carlisle, Ald. T. L. Macdonald, seen here (second from right) in a Rapide of Cumberland Aviation Services Ltd

NO NEED FOR DULLES INTERNATIONAL?

IT is still doubtful how much use will be made of Washington's new Dulles International Airport when it is completed, for it was built without hangars on the assumption that airlines would build their own on leased airport ground; so far, it seems, no airline has shown any interest in this direction.

The FAA's Administrator, Mr Halaby, said recently that the FAA might have to build one hangar, at a cost of $6m; and that in addition to the $85m already authorized a further $20m would be needed, plus $30m to provide Customs and other facilities. These figures were mentioned at recent hearings of the House Independent Offices Appropriations Sub-Committee.

One factor militating against the new airport is that airlines may be reluctant to leave Friendship, to the south of Baltimore, which is rapidly becoming the Washington jet terminal. A request for $22½m has been made to the Baltimore Planning Commission for a building programme at Friendship over the next six years in the expectation of continued traffic growth.

RAIL/AIR TO LUXEMBOURG

LUXEMBOURG is now about eight hours from London as the result of the recently inaugurated Channel Air Bridge rail/air/rail service. This is an extension of the services already operated to destinations in Belgium in conjunction with British Railways (Eastern Region) and Belgian National Railways; bookings can now be made to stations on Luxembourg Railways. The air part of the journey, between Southend and Ostend, is by Bristol 170, although Carvairs will probably be used eventually.

Captain "Scotty" Allan, seen here alighting from the Fokker F.VIIb/3m "Southern Cross," in days when he flew with Sir Charles Kingsford Smith, has recently retired as deputy chief executive and deputy general manager of Qantas

VOICE RECORDERS FOR AUSTRALIA

QANTAS and TAA have ordered Lockheed 109C flight recorders, with voice-recording units, for all their turbine-powered aircraft. Ansett-ANA, too, is expected to order the same type. This follows the recommendation of the court of inquiry into the TAA Friendship crash at Mackay last year. The Australian Minister for Civil Aviation approved the court's recommendation that flight recorders with voice units be made mandatory. The Department of Civil Aviation has accordingly made their use compulsory from January 3, 1963, but recorders will in fact be installed in Australian airliners before the end of next year.

Lockheed Aircraft Service Inc have already sent out trial equipment with a small voice-recording unit. They are offering to include all Australian turbine operators in a mass deal for 100 units, and this would allow individual operators to enjoy a reduction in price. Other operators include Mac.Robertson-Miller and East-West (each of whom has one Friendship) and Associated Airlines, who operate a Grumman Gulfstream for Broken Hill Pty. Friendships are also operated by Airlines of NSW, Airlines of SA, and Queensland Airlines, but these aircraft would automatically be equipped from the Ansett-ANA order.

Australian operators, it is reported, were greatly impressed by the Lockheed equipment's ability to go on recording ten minutes after power cut-off. The six parameters required by the DCA are: cockpit voice, altitude, reading, airspeed, vertical acceleration, and time. The voice recorder is limited to the flight deck and will have a cut-off for use by the crew in any discussion of private matters. The Australian Federation of Airline Pilots has agreed to the system, but in reply to one of its objections DCA has ruled that voice recording will be self-obliterating after 120min.

Footnote: In April 1960 Royston Instruments Ltd announced an agreement with Lockheed Aircraft Service whereby the latter would offer, in addition to its own 109C equipment, the full line of data recorders and data-reduction equipment developed by the British firm.

AIR CEYLON'S FUTURE

THE international services of Air Ceylon might be suspended if a new policy recommended by the Minister of Transport, Mr P. B. G. Kalugalle, is put into effect. The Minister is said to favour an "open door" policy allowing more foreign carriers into Colombo in place of the current policy of protectionism towards Air Ceylon's services to London and Singapore.

The reason for this change of heart is that there is not enough money to make Air Ceylon's services more competitive by ordering jets; an Electra leased from KLM operates a once-weekly service to London and to Singapore. KLM has not yet decided on a medium jet, and although the Dutch airline would presumably be willing to lease one to Air Ceylon to replace the Electra, some months will elapse before Air Ceylon would be able to offer jet travel, during which traffic would be lost to airlines scheduling more competitive equipment through Colombo. The Minister has recommended that if Air Ceylon's operations are suspended the airports of Ratmalana and Katunayake should be opened to foreign carriers wishing to add Colombo to their networks, thus enabling the country to earn more in tourist revenue, landing fees, parking and housing charges. The airline's recent history has not been an entirely happy one: there have been disputes between pilots and management, charges of management maladministration and a feeling among the pilots that Air Ceylon's association with KLM, airline of an allegedly "colonialist" power, has prevented it from acquiring new routes. In spite of these difficulties, Air Ceylon showed an overall profit of 189,960 rupees for the period April 1958 to March 1959 according to the latest audited statements, and this is the fifth successive year in which a profit has been made.

BOOM IN SOUTH AFRICAN TRAFFIC

SURPRISINGLY, in view of the troubled African political scene, South African Airways, with other operators to the Republic, is experiencing an unprecedented boom in international traffic. "The airlines' most optimistic hopes of traffic increases to fill the available seat capacity of the big jets," writes a correspondent, "appear to have been fulfilled." The Springbok partners—SAA, BOAC, CAA and EAAC—now offer 1,100 seats a week between Jan Smuts Airport and London in 13 jet flights. Alitalia's former quota of 100 passengers a week out of Jan Smuts has been increased to 140 a week, and UAT has replaced its DC-6B flight to Paris with a second DC-8 frequency, but retains DC-6Bs on its service from Paris to Livingstone, Northern Rhodesia. UAT is the only carrier providing a direct connection from Victoria Falls to Europe, a service which is much appreciated by South Africans who want to spend a weekend at the Falls before going on to Europe. PanAm is planning a second jet service from New York to Johannesburg, and is likely to give the Union its first direct connection with Lagos, going on to New York via Lisbon.

Lufthansa is planning to operate a service to Jan Smuts, probably before Christmas. Maj-Gen F. W. von Mellenthin, until recently commercial director of Trek Airways and a well-known figure in South African air transport, has been appointed to Lufthansa's planning staff in Cologne as its African affairs expert.

AIR COMMERCE...

ATLB's 21st Hearing

(continued from pp 16-17)

Mr Gardiner then asked whether BEA intended to operate from Heathrow or Gatwick, since both airports were mentioned in their applications. Mr Milward replied that they would use either; a letter from the Minister, which he quoted, advised BEA that Gatwick and Heathrow were considered to serve the same area and no permission would, therefore, be required for a transfer to Gatwick.

To further questions Mr Milward replied that no term had been set to the licence applications, but he would regard ten years, the normal write-off period for aircraft, as reasonable. Replying to questions about frequency limitations, he did not agree that these were always imposed on other operators; in cases where there was no opposition, limitations on frequency were not always imposed. There might be reasons why BEA's frequencies should now be restricted but he would prefer that they should not be.

Mr Gardiner then asked about BEA policy on fares. Mr Milward replied that BEA had forced a steady policy of reduction with IATA. It was not now so easy to pursue this policy, because of rising costs; across-the-board reductions were no longer possible, but more low fare services were being introduced. Replying to a question on present policy he said that European airlines were pressing for a 5 per cent across-the-board increase this winter and BEA would go along with them. Asked when there had last been a reduction in fares comparable to those which had been made on the Atlantic routes, Mr Milward replied that there had been no across-the-board reduction since 1953. Although there had been reductions on the Atlantic the rates on that route were still higher than in Europe. He did not agree that a general decrease would be an economic possibility and quoted Mr Wyatt, chairman of BUA, as having said that the trouble with civil aviation was that the fares were 10 per cent too low.

Mr Gardiner then asked whether Mr Milward agreed with the figures for estimated costs and revenue yield in the table M.27 in document BUA 1 for Viscount and BAC-111 aircraft. Mr Milward said that the costs agreed with BEA figures, but he would not agree that lower fares were possible at these costs. The figures for the BAC-111 were speculative. Asked whether the documents BEA 1 and BEA 2 were intended to support BEA's application or their objections, Mr Milward said the documents were intended to satisfy the Board about BEA's economics.

Closing his cross-examination, Mr Gardiner asked whether BEA's profits in recent years had offset past losses; it was stated at the bottom of page 10 of the BEA brochure that "as a result of the profitable last seven years, we have been able to write off all development costs and intangible assets and have created reserves now standing at over £4m." Mr Milward referred to the chart at the bottom of page 11 of the same brochure which showed that the gross losses were greater than the gross profits.

Mr Milward was then re-examined by Mr Marking, in answer to whose questions he said that the four new routes came within the terms of pooling agreements; he thought that BUA considered the Malaga application important in connection with the BUA/BEA pooling agreement on the London - Gibraltar route.

Mr Marking also asked when Mr Wyatt had said that he thought European fares should be raised by 10 per cent, and Mr Milward said that he wanted to be quite fair; his recollection was that, on January 26 this year, Mr Wyatt had said that the fares were 10 per cent too low.

Mr Marking then referred to operating costs set out in document BUA 1 for BAC-111 aircraft and asked what relationship Mr Milward had found to exist between manufacturers' estimates and actual achievements. Mr Milward said that the manufacturers' figures had always been found to be too low. This concluded Mr Marking's re-examination of Mr Milward and the Board had no questions to ask the witness.

As there were no further witnesses in support of BEA's general case for their applications, Mr Wyatt was next called to give evidence in support of BUA's case. Mr Wyatt was examined by Mr D. L. McDonnell. In his answers, Mr Wyatt outlined the activities of independent companies from 1944, with the expansion, within the limits set by the law, up to 1960. The Ministry, he said, had urged the formation of larger firms so that fleets would be bigger, utilization higher and the firms more substantial. The same policy had been dictated by economic considerations.

Mr Wyatt was then asked about the structure of British United Airways and shipping interests in the company. Seventy-eight per cent of the capital was held by or on behalf of shipping interests. Copies of the draft balance sheet for the last financial year would be put in at the next hearing. A 1959 balance sheet had been lodged with the Board, but this was before the formation of BUA.

On the subject of replacements for Viscounts, which were no longer sufficiently modern to be competitive, Mr Wyatt said that negotiations for the purchase of BAC-111s were in their final stages. These aircraft would be paid for without additional funds. They were due for delivery in 1964/65, for use on European routes. VC10s, due for delivery in 1964, would require additional financing; the principal shareholders agreed with the company's aircraft purchasing policy. Profits, before taxation, had been £396,000 in 1957, £709,000 in 1958, £302,000 in 1959 and £399,000 in 1960. These figures included depreciation of aircraft over ten years for Britannias, eight years for Viscounts, seven years for Bristol Freighters and six years for helicopters. An agreement had been negotiated with the British Transport Commission for an air terminal at Victoria, to serve Gatwick. This terminal would be available to other operators. Mr Wyatt concluded by saying that it was the policy of BUA to press for the lowest possible fares; the company thought that it would be possible to press for fare reductions.

Mr Marking then opened his cross-examination of Mr Wyatt on behalf of BEA by asking whether Mr Wyatt had been asked to advise on the drafting of the new Act; he said his views had been known to the British Independent Air Transport Association, which had been consulted. Asked whether he thought that the Act gave the independents what they should have, Mr Wyatt said that it was not possible to express an opinion as no case law had yet been established. He suggested that the Act did not give all that BIATA had wanted. He would not agree that the Act would not allow operation in parallel with the corporations; this must emerge from decisions yet to be made.

Mr Wyatt agreed that he would say that the Act was intended to further the development of British aviation and that a healthy industry must result. BUA's past profits were healthy by aviation standards, but not necessarily by other commercial standards. He felt that still greater scope was due to the independents because heavy financing was required for fleet modernization.

Mr Marking then turned to the refusal of the chairman of BEA to meet Mr Wyatt, and Mr Wyatt agreed that, at the time of the exchange of letters, the BUA applications had already been submitted to the Board. Mr Marking referred to press reports of a statement by Mr Laker, at the time ten BAC-111s were ordered, that these were for existing routes and would be supplemented by five aircraft, on which options were held, should the applications for European routes be successful. Mr Wyatt said that he could not recall details and referred to page M.26 of document BUA 1 (this includes the new European routes in the task for which the ten BAC-111s are required).

In reply to further questions from Mr Marking, Mr Wyatt said that the Victoria station air terminal would be used by all passengers from London travelling via Gatwick. They would be numerous but would not be all the passengers travelling from Gatwick. Mr Marking con-

*Two new airline colour schemes for a brand-new turboprop: below, one of Flying Tiger's ten Canadair CL-44s; and r*ight, one

tinued with other questions to suggest that Gatwick traffic would be drawn largely from the London area.

Questioned on the remark he was said to have made about fares being too low by 10 per cent, Mr Wyatt said that this remark (six months ago) might have been made in jest or with reference to current types of aircraft. It was being quoted out of context.

Mr Marking's final questions to Mr Wyatt were on the operation of jet aircraft. Mr Wyatt admitted that BUA had no experience of operating large commercial jet aircraft, although they had operated small military types in the past. Asked why BUA relied on manufacturers' figures, Mr Wyatt said that they did not. They modified the manufacturers' figures in the light of their experience.

This concluded Mr Marking's cross-examination of Mr Wyatt, and Mr Oswald, for the British Transport Commission, advised the Board that BTC were not objecting to any of the BUA applications. Those which interested the Commission had been withdrawn.

Re-examined by Mr Gardiner, Mr Wyatt said that his views on European fares were as stated. He also referred to a letter which he had received from Mr Milward in reply to his suggestion of a meeting between himself and the chairman of BEA. This letter stated that the BEA chairman was out of England at the time, but suggested that an appointment might be made on his return. The subsequent letter from Lord Douglas, however, merely said that no useful purpose could be served by such a meeting.

The second witness for BUA was Mr D. A. Whybrow. Replying to questions from Mr Gardiner, he said that he had been responsible for the statistics presented in the two documents, BUA 1 and BUA 2. Mr Gardiner then examined Mr Whybrow on these statistics. Mr Whybrow's evidence showed that an increase of 60 per cent in the traffic to the countries for which BUA sought licences might be expected by 1965. This compared with BEA's estimate of 50 per cent over the period 1959/65.

BUA's estimated traffic would represent only 20 per cent of this increase. Special factors affecting various routes would be explained in the detailed evidence on the individual applications.

Mr Marking began his cross-examination of Mr Whybrow by asking his status with BUA, to which Mr Whybrow replied that he was the company's commercial adviser. Mr Marking then proceeded to a detailed examination of the figures used by BUA and the comparison between European and Atlantic fares. He asked why winter excursion and night fares had not been included for Europe whilst they were included for the north Atlantic. Mr Whybrow said that these figures could not be shown on the present charts; new charts would have to be drawn. Mr Marking said that this was what he had done, and produced copies for the Board and for BUA.

When Mr Marking began comparing the indications of the charts he had produced with those from BUA there was a protest over the inclusion, in his version, of inclusive tour fares. There was considerable general discussion over the admissibility of these, since they are not available to individuals, and the chairman suggested that the meeting be adjourned at that point, to allow all parties to study the new evidence.

[To be continued: see also page 2.]

BREVITIES

Finnair has purchased a Convair Metropolitan from Alitalia, and now operates seven aircraft of this type.

Air Safaris has doubled the frequency of its Hurn - Dublin - Belfast services; these are now operated four times a week with Vikings.

Delta is expected to order about six new turbofan jets for its new southern transcontinental route, opened on June 11.

Air Cameroun DC-4 TJ-ABC became a total loss at Douala in the Cameroons on June 13. Circumstances are not yet known.

After a recent tour of Western Europe, George R. Sanborn, transport sales director of Boeing, reported that his company expected to sell $60m-worth of jet airliners to European carriers.

United Air Lines has discussed with Boeing the possible use of boundary layer control on its 727s, but no firm decision has yet been reached. BLC would not appear on initial 727s.

According to *Interavia*, Saudi Arabian Airlines is reported to have signed a letter of intent for three Boeing 727s with an option on three more.

A new Dutch company, Sinberg Luchvaartbedrijf, is to fly scheduled services for holidaymakers between Schiphol and the island of Texel. Two Jodel Ambassadeurs will be used.

The contemplated amalgamation of the helicopter interests of Autair Helicopter Services Ltd and Spartan Air Services Ltd will not now take place, since the parties were unable to agree on several of the terms and conditions of amalgamation.

The 1960 annual report of the Netherlands Aircraft Development Institute, a government body which finances the development of aircraft projects, has been discussing a Friendship replacement with Fokker. This is believed to be a short-haul jet airliner, designated F-28.

British United Airways plans to introduce a second Viscount service between Gatwick and the Canary Islands on October 7.

Ghana Airways has inaugurated the first non-stop Accra - London service on June 25; Britannias are used and frequency is once-weekly.

TWA has requested the temporary suspension of its services at Bangkok and Colombo in an application to the CAB.

A United Arab Airlines Viscount has reopened the Nicosia - Cairo service, suspended since the Suez crisis of 1956.

Extensions to Nairobi Airport's main runway to give a total length of 13,500ft will begin in August. Big jets operating through Nairobi at present suffer payload restrictions.

Enrolment for City of London College air transport courses takes place on September 19/20. These courses cover Law, Economics and Operations.

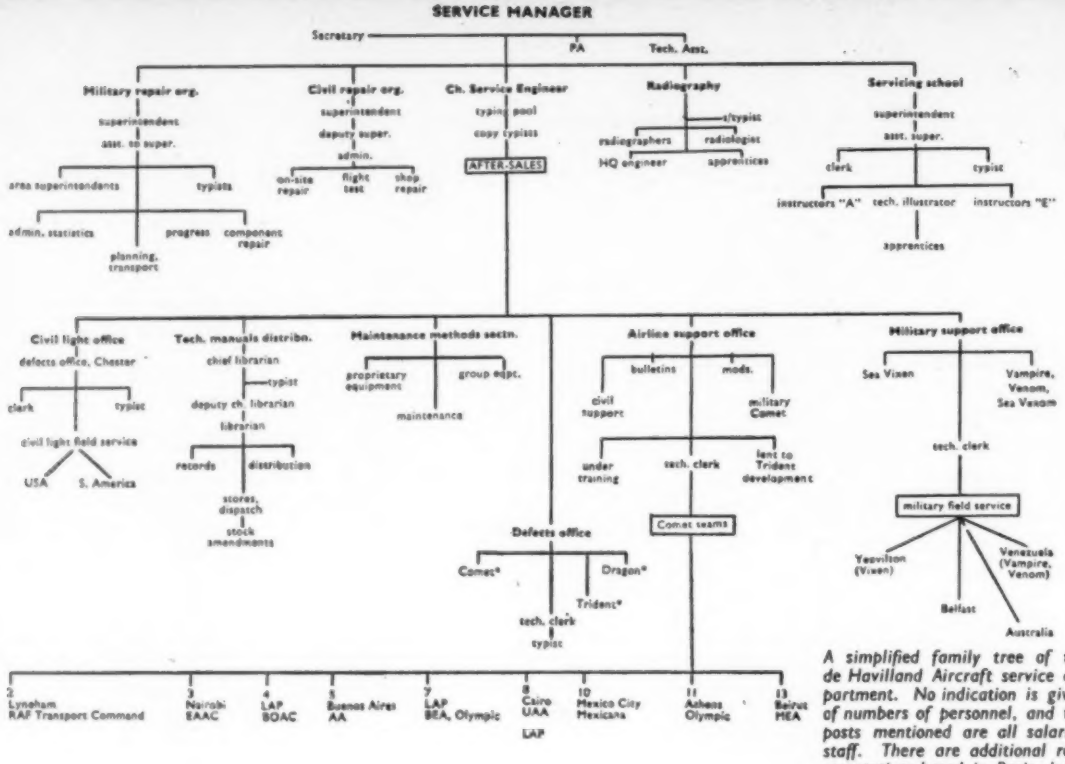
Membership of the ICAO Council has been increased from 21 to 27 states to keep pace with the greatly increased number of ICAO member states.

Overseas Aviation has decided to sell its Elizabethans and to introduce North Stars or Argonauts on July 31 on their Gatwick - Manchester - Prestwick service. In last week's issue it was stated that Elizabethans would be used on this route.

United will start Caravelle services on July 14 between New York and Chicago non-stop. Three daily round-trip flights will be scheduled, including the after-business hours eastbound "New York Executive" and westbound "Chicago Executive" services for men only.

Portugal has refused to allow CSA landing rights at Lisbon or the Azores for the Czech airline's proposed Prague - Havana service using Cubana Britannias and Czech crews. Cubana began service to Prague on February 28, and now operates twice-weekly via Bermuda and Santa Maria.

...L-44s; and (right, one of the five CL-44D4s of Seaboard World Airlines, until recently known as Seaboard and Western Airlines



A simplified family tree of the de Havilland Aircraft service department. No indication is given of numbers of personnel, and the posts mentioned are all salaried staff. There are additional representatives based in Paris, India and Japan. Asterisks indicate that design staff are included

AFTER-SALES SERVICE

A Briefing by Hawker Siddeley Aviation

OF all the manifold aspects of aviation covered by this journal, few are more dull than that of after-sales service; and none is more important to the continued well-being of both constructors and operators of modern aircraft. Last week Hawker Siddeley Aviation told us much of the background to their enormous efforts in this field, particularly by Armstrong Whitworth Aircraft, de Havilland Aircraft and A. V. Roe Ltd, who have been pooling their experience in the civil market, with a view to adopting a common practice wherever this is advantageous to the customer. And today's customers are white men, black men, yellow men and brown men.

The whole subject is so vast that one could talk for days about ATA.200 alone—something about which, in all probability, the majority of our readers have never heard. After-sales service embraces the supply of spare parts from hundreds of subcontractors, the determination of optimum overhaul procedures, the training of air and ground staff, providing communications so swift and reliable that the most trivial malfunction on the other side of the world is at once known in the manufacturer's plant and pondered upon by the men who designed the aircraft. It is reflected in the legal language of contracts, the manifold aspects of warranties, aircraft cruise-control procedures and the planning of schedules to suit fleet requirements.

Britain's aircraft industry is not unusual in that it grew up in an essentially military atmosphere, in which late delivery and poor reliability used merely to mean reduced fighting effectiveness and an increased burden upon the taxpayer. Today the chief customers are the world's airlines, and the keen wind of competition which affects their operations is felt equally by the manufacturers of their equipment. It is hard to believe that there ever was a time when a manufacturer could say to an airline: "You've bought our aeroplane; now you can jolly well get on with it." A modern airliner loses something like £3,000 every hour it is on the ground. Time therefore emerges as an implacable enemy, and most of the vast effort and expense of airliner after-sales service is aimed at reducing months to weeks, and weeks to hours.

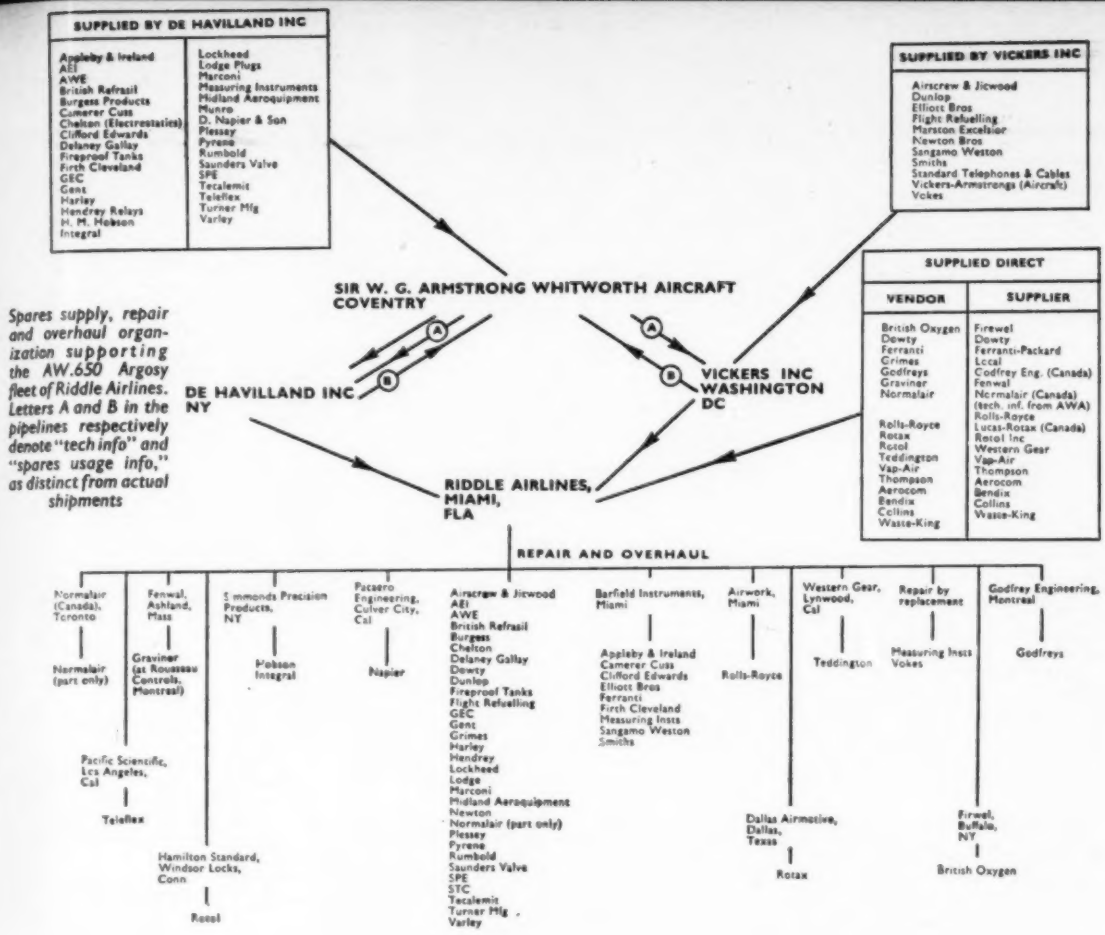
When an operator buys a fleet of new turboprop or turbojet aircraft he does so only after the most careful evaluation of it, and of its immediate rivals. Yet, when he takes delivery, he knows practically nothing about the aircraft, apart from what he can be told, or reads in a book; and this applies particularly stringently if he is the first operator of a new type. No matter how searching may be the flight-test and certification programmes, it is impossible to find out very much about a new transport until it gets into the hands of the customer. When a major British manufacturer sells to a major world airline (especially a British one) the process should be relatively smooth; although even in such cases the word "relative" may have a great deal of meaning. The problems really begin when one starts selling modern airliners to Ombo Bongo Airlines (the name *is* fictitious); for this sort of operation is fraught with such difficulties that it is worth relating a few here.

First, the aircrew have to get their endorsements on the new type, and this is naturally assisted by the manufacturer in every way possible. The crews have to be taught not only how to fly the aircraft, but how to operate it in the most profitable manner, and this involves learning a whole range of techniques which simply did not exist with piston-engine equipment. But this is a trivial undertaking compared with teaching the airline to maintain their aircraft, providing for supplies of spare parts from the airframe manufacturer and arranging a complete distribution service for proprietary equipment. The operator must be taught maintenance schedules and procedures, and given complete provisioning information to ensure that he buys the right types of spares, and in the statistically correct quantities.

This type of work calls for a large team of very carefully chosen men. Supporting the customer has gradually evolved from an irksome duty to being a challenging profession; and those whose full-time job it is are, in general, highly paid monthly executives who combine solid engineering training with the essential ability to get on well with all kinds of people—it was put to us that "the last thing we want is a PhD with bad breath." Ultimately, of course, every single employee must be a servant of the customer, and it is probably true that the fortunes of more than one company have suffered because this fact was appreciated only by a few.

If an aeroplane goes wrong, the man legally responsible is the designer, and everyone connected with after-sales has to keep at least one foot in the design department. The technical representative in the field must learn of every pulled rivet and every incipient crack; and if a rivet goes 3ft away (possibly in another aircraft) he must be able to determine a pattern of failure and pass it to the design department back home. Records of defects not only lead to essential modification action on the type concerned but may also be invaluable to the teams designing and developing later aircraft.

As a result of the sheer scale of their operations the most experienced air-transport nation is the United States, and one manifestation of their lead is in their standardization of literature. The US Air Transport Association have laid down in specification ATA.100 precise instructions upon how to write the maintenance manual for a modern airliner, and the United Kingdom and all other Western manufacturers of transport aircraft have adopted it in every detail. This is no mere slavish copy of something which we could have



Spares supply, repair and overhaul organization supporting the AW.650 Argosy fleet of Riddle Airlines. Letters A and B in the pipelines respectively denote "tech info" and "spares usage info," as distinct from actual shipments

done ourselves; it is of literally vital importance to every operator that he should know how the manuals are written so that he can thread his way through their tortuous pages at high speed. Were this not so, the operator might have a big jet sitting on the ground for a whole day while his engineers feverishly pored through 89 volumes, each with a 4in spine (Douglas Aircraft recently calculated that if one copy of every DC-8 publication was placed on a shelf, the shelf would have a length of just under eight miles). Earlier in this account ATA.200 was mentioned; this is the book which outlines how to order, invoice and ship spare parts, using common paperwork throughout the world and with a complete interchange on a punched-card basis.

Apart from Rolls-Royce, who have at least 80 technical representatives with civil and military engine customers abroad, the largest aeronautical service department in Britain is that of de Havilland Aircraft. The family tree shown here is drastically simplified, and gives no indication of the large number of personnel involved, but it provides an outline of an organization which has gradually evolved during many years of experience.

Before a DH jet is delivered, the following services are offered: an optional five-day course on the aircraft for the airline management; discussion between the aerodynamics department and the customer's operations staff to facilitate the preparation of tables and charts for aircrews and dispatchers, runway charts, and solutions to local performance problems; discussion with the maintenance methods office, probably involving visits by specialists in ground equipment and liaison personnel with the major vendors of proprietary equipment; preparation of a complete spares recommendation, in the form of large, loose-leaf volumes; training of aircrew and ground engineers, which also involves courses at the schools of major vendors; and the issue of technical publications, including modern manuals to ATA.100, monthly or immediate amendments, and publications for aircraft no longer in production but still in use.

When aircraft are in service, de Havilland pilots and flight engineers assist in the initial operations, while technical representatives reside with the operator for a much longer period. Initially the "reps" comprise a carefully selected leader with extensive field and headquarters experience, and pairs of mechanical and electrical engineers, the number of such pairs depending upon the operator concerned. And a book could be written about the work of the spares office at Hitchin, the repair and overhaul services, and the defects office (where may be found design engineers working on types of aircraft still on the drawing board).

The other family tree concerns another of the Hawker Siddeley Aviation companies making modern transport aircraft. Armstrong Whitworth's first civil customer for the Argosy is an operator based 4,000 miles away and with a firm commitment to the United States Government to fulfil essential Logair contracts requiring a daily utilization of 13hr (4,200hr per year). Riddle Airlines have five Argosies in operation, and the last two are being flown across to Miami this month. One of the aircraft has been used for crew training, but the others have already been averaging nearly 10hr per day on Logair routes. The usual mission is a multi-stop round trip from Tinker AFB (Oklahoma City Air Materiel Area), requiring a flight-time of 13hr, and it is not unusual for an Argosy to fly two such trips in immediate succession.

Such performance supports Armstrong Whitworth's claim that utilization has not been affected by the agreed Airworthiness Directive calling for daily inspection of the tail unit, pending a complete cure to local cracking of the skin as a result of turbulence at the fin/tailplane junction. The manufacturer states, "A fully modified aircraft has proved that this problem has now been completely overcome, and the last two aircraft to be delivered will be fully modified and completely unrestricted. The final modifications entail the strengthening of the tail unit structure in the region of the fin and the tailplane junction, together with aerodynamic sealing." A working party from Coventry is about to leave to complete the modifications to Riddle's first three aircraft.

It is worth noting from the chart outlining Riddle's support network that Hawker Siddeley Aviation provide part of their service through Vickers-Armstrongs (Aircraft) Inc, members of the rival British Aircraft Corporation. This is a natural result of the fact that the powerplants and many other portions of the Argosy are similar to those of the Viscount, for which a world-wide after-sales organization already exists. Later in the year Avro will have their 748 in service. They are adopting the AWA spares-provisioning system, and both companies are working closely with their giant new colleague at Hatfield. And the attitude of the latter may be summed up by this quotation:—

"It's all a matter of getting your priorities right. It's no good letting your service engineers loose on glamorous projects upon which they can address the Royal Aeronautical Society if somebody's airliner at Entebbe has a toilet door which won't latch properly."

Cody's biplane and Gustav Hamel's Bleriot monoplane at Harrogate on July 24, 1911, in the Circuit of Britain Race for the "Daily Mail" £10,000 prize. (See letter below from Mr Bertram Robson)

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Comanche Round France

A BELATED word of congratulation to Mark Lambert for his account of a journey round France in a Comanche (*Flight*, June 1, 1961).

With its touch of caution born of experience—the references to careful flight planning and methodical operation despite the advantages of an automatic pilot and VOR—this article comes as a refreshing change to some of the more hair-raising accounts of recent flights within the United Kingdom and Europe by other contributors to *Flight* who seem to rely solely upon an unusual degree of self-confidence to offset their impressive lack of experience and common sense.

Welwyn Garden City, Herts — DAVID B. BROWN

Full Marks for SAS

IN your issue of June 8 Roger Bacon told the sad story of one of his colleagues being caught by the check-in rules at London Heathrow. There are, however, bright exceptions!

On June 9 I arrived in Copenhagen with a friend at 1645hr after having plodded along three hours from Helsinki per Metropolitan. We had some three hours to spare as we had been booked on a flight to Amsterdam departing at 2000 hr.

After refreshing ourselves a bit we walked leisurely along the shops in the big waiting hall as we heard a SAS flight to Amsterdam being announced. We expressed some rather unfriendly feelings towards those who had arranged our bookings. After the final call for this flight my friend suggested trying to rebook on this flight. I must have stared somewhat frigidly at such an impossible suggestion. However, we went to the exit.

All passengers had already boarded. We showed our "wrong" boarding passes and asked whether we could still join the flight to Amsterdam. The SAS official immediately picked up the phone and three minutes later we boarded the Caravelle duly rebooked!

SAS could not guarantee my suitcase being found in time. We arrived more than three hours ahead of our original schedule in Schiphol and found that one had even managed to get the suitcase aboard!

I think you'll agree with me: full marks for SAS!

Rotterdam — J. H. BROUWER

Round-Britain 50th Anniversary

I AM sending you an account and photographs [one of which is reproduced above.—Ed] of the round-Britain race for the *Daily Mail* prize of £10,000 which took place fifty years ago—in July 1911—and which I hope may interest your readers. I remember well the planes landing and taking off at Harrogate.

The race was the biggest event the world had known.

Harrogate was the second stop from Hendon. Jules Vedrines was the first to arrive in a Morane-Borel monoplane. He had previously won the famous Paris-Madrid Race. Five minutes later Lt Jean Conneau ("Andrea Beaumont"), a French Naval officer, arrived. These two were driven around the course for all to see. Vedrines and Conneau were in the air again before the first Englishman arrived—James Valentine in a Deperdussin monoplane. He was presented with a Queen Anne tea service, value £50, subscribed for by the Harrogate Chamber of Trade for the first English pilot to arrive at Harrogate.

Almost an hour after Valentine had left a massive biplane was seen, no other than S. F. Cody. Cody claimed to be the first man to fly in Britain. He descended first near Rotherham with a burst water-pipe; when repaired he flew on to Harrogate. A sensation was caused when Gustav Hamel arrived, almost unconscious, in a monoplane which had made a natural safe landing, without control. His face was pale and he was in a very weak state, but a dose or two of neat brandy soon brought him round. He landed first at Melton Mowbray and had been very much buffeted by the wind and suffered from air sickness.

Such was a thrill-packed Circuit of Britain Race, and Yorkshire's small but eventful part in it.

Whitby, Yorks — A. BERTRAM ROBSON

Prestwick Display

I READ the report in *Flight* for June 22 about the USAF Open Days on June 17. In the report you stated that five bases were open to the public. This is incorrect as at least one other base was open, namely Prestwick. Here, as compared with the other bases, there was no flying display due to its position as a transatlantic civil airport, but a static display had been arranged consisting of the following aircraft; Destroyer, Beaver, Voodoo, Super-Sabre, KB-50J, Globemaster, T-33A, Albatross, SC-54D, Javelin, Twin Pioneer, and Sabre and CF-100 of the RCAF.

An Albatross demonstrated a JATO take-off and later dropped parachutists.

Carlisle, Cumberland — J. HUGGON

[Prestwick is not a USAF base, though MATS aircraft operate into it and a USAF air-sea rescue squadron is based there.—Ed]

Two-Stroke Engines

I WISH to thank Mr C. L. Wills for his letter concerning the NEC two-stroke engine fitted and flown in a Short-built Baby Wright by Mr Alec Ogilvie (*Flight*, Correspondence, June 22), who afterwards wrote the following:

"The engine is really a beauty, with a lot of power and excellent balance. Its smoothness of explosion makes it very good for chain work" (*Flight* back cover advertisement, January 14, 1911). I am now wondering whether Mr Wills can compete with Mr H. Heath as being *Flight's* oldest reader—though I doubt it (Hamel handbill, same page, June 22 issue).

Returning to engines, can any American reader give any details about the 1926 350 h.p. Almen Barrel engine? Precisely what *was* in the barrel? Finally, I would like to acknowledge Mr R. N. Bell's letter (*Flight*, September 30, 1960) about the Vickers Virginia's engines. Of course they were Napier Lions—I can offer no excuse.

Birmingham 14 — MAURICE AUSTIN

"What Use is a New-born Babe?"

RE page 641, *Flight*, May 11 (Roger Bacon's "Straight and Level"): who is ill-read, Roger or the Editor?

The remark attributed to Franklin by Bacon and to Faraday by the Editor is attributed by Peterborough of the *Daily Telegraph* (page 14, June 6) to Sir George Cayley.

This seems too near home for your aeronautical types to have missed.

Yours irreverently and illiterately,

St Albans, Herts — H. W. WHEELER

[I still say Faraday.—Ed]

FORTHCOMING EVENTS

July	6-8	Italian Aero Club: International Aviation Contest, Rome-Turin.
July	8	RN Air Station Abbotsinch: At Home.
July	8-9	Vittel Aero Club: Doctor-Pilots' Rally.
July	9-10	Turin Rally.
July	10-16	Aslib Aeronautical Group: Annual Conference.
July	12-19	University of Southampton/AGARD: Seminaron Astronautics.
July	13-15	RAeC: Lockheed International Aerobatic Competition and King's Cup Air Race, Baginton.
July	14-15	Marseilles-Provence Aero Club: Rally, Mejane.
July	14-16	Aerial Tour of the Pyrenees.
July	14-23	Angers Gliding Week.
July	15	RN Air Station Culdrose: At Home.

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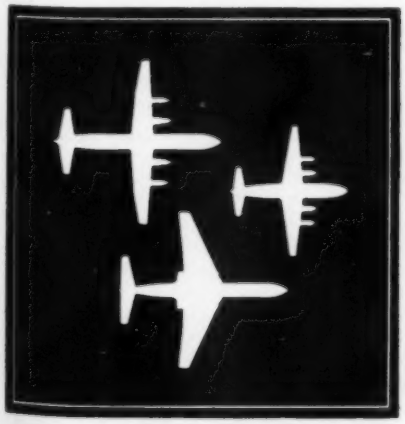

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INDEX TO ADVERTISERS

	Page
Aer Lingus	21
Aeronautica Macchi S.p.A.	7
Airwork Services Ltd.	16
"Amateur Photographer"	6
Automotive Products Ltd.	4
Boeing Co., The	*Cover iii*
Boulton Paul Aircraft Ltd.	*Cover i*
British Aircraft Corporation	2, 3
British European Airways	19
British Institute of Engineering Technology	21
British Refrasil Co. Ltd.	4
Civil Service Commission	20
Clifford & Co. Ltd., Peter S.,	16
Cross Manufacturing Co. (1938) Ltd.	16
Cunard Eagle Airways Ltd.	18
Decca Radar Ltd.	1
English Electric Co. Ltd., The,	10
Flight Refuelling Ltd.	12
Godfrey & Partners Ltd., Sir George	5
Handley Page Ltd.	13
Hawker Siddeley Aviation Ltd.	8, 11, 18
Hunting Aircraft	20
Iliffe Books Ltd.	14
International Aeradio Ltd.	18
Keegan Aviation Ltd.	16
Marshall's Flying Services Ltd.	21
McDonnell Aircraft Corpn.	*Cover iv*
Ministry of Aviation	21
Normalair Ltd.	*Cover ii*
Orchard & Ind Ltd.	6
Oxford Aviation Ltd.	16
Pressed Steel Co. Ltd.	18, 21
Robinson & Co. (Gillingham) Ltd., L.	14
Rogers Ltd., W. H. & J.	16
Rolls-Royce Ltd.	9
Shackleton (Aviation) Ltd., W. S.	17
Short Bros. & Harland Ltd.	16
Staravia Ltd.	16
Stream-Line Filters Ltd.	14
Vigors Aviation Ltd.	16
Vokes Ltd.	20
Westland Aircraft Ltd.	15, 22

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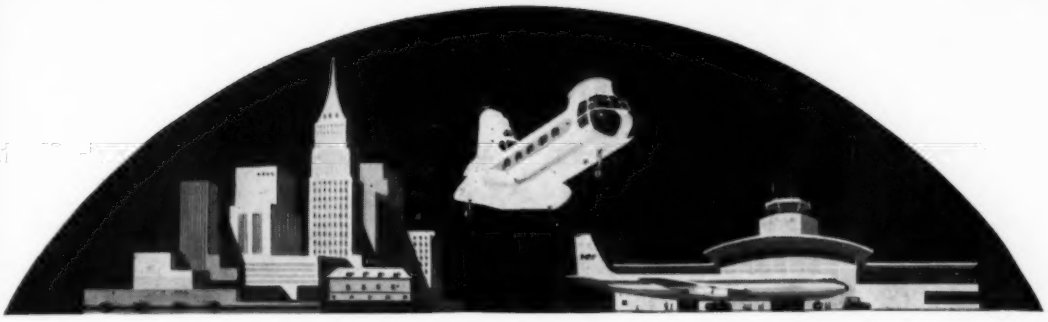

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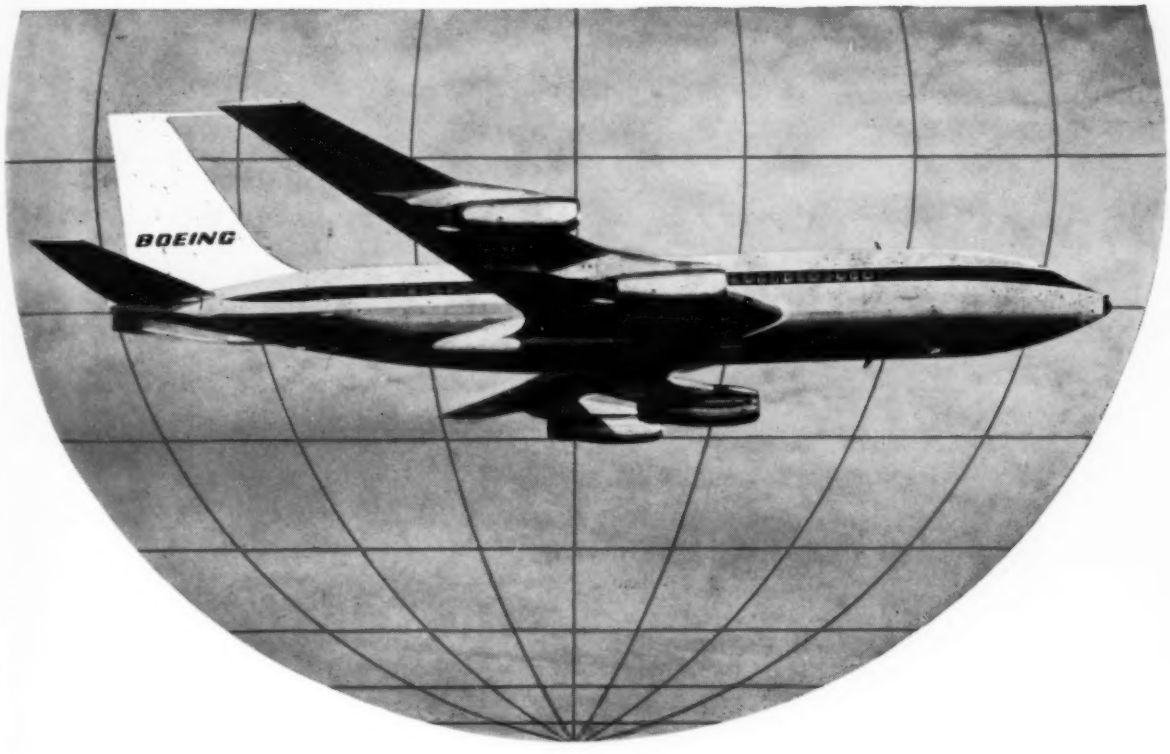

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